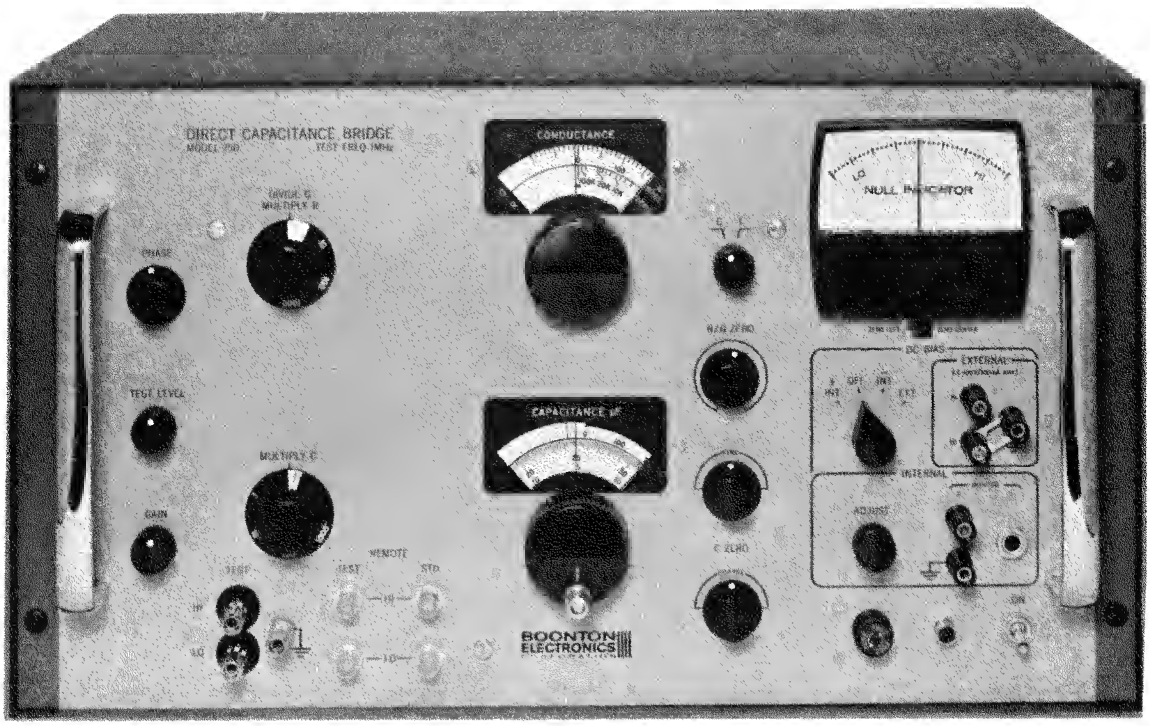
DIRECT CAPACITANCE BRIDGE, MODEL 75D (1 MHz)

INSTRUCTION MANUAL



75D
b-370

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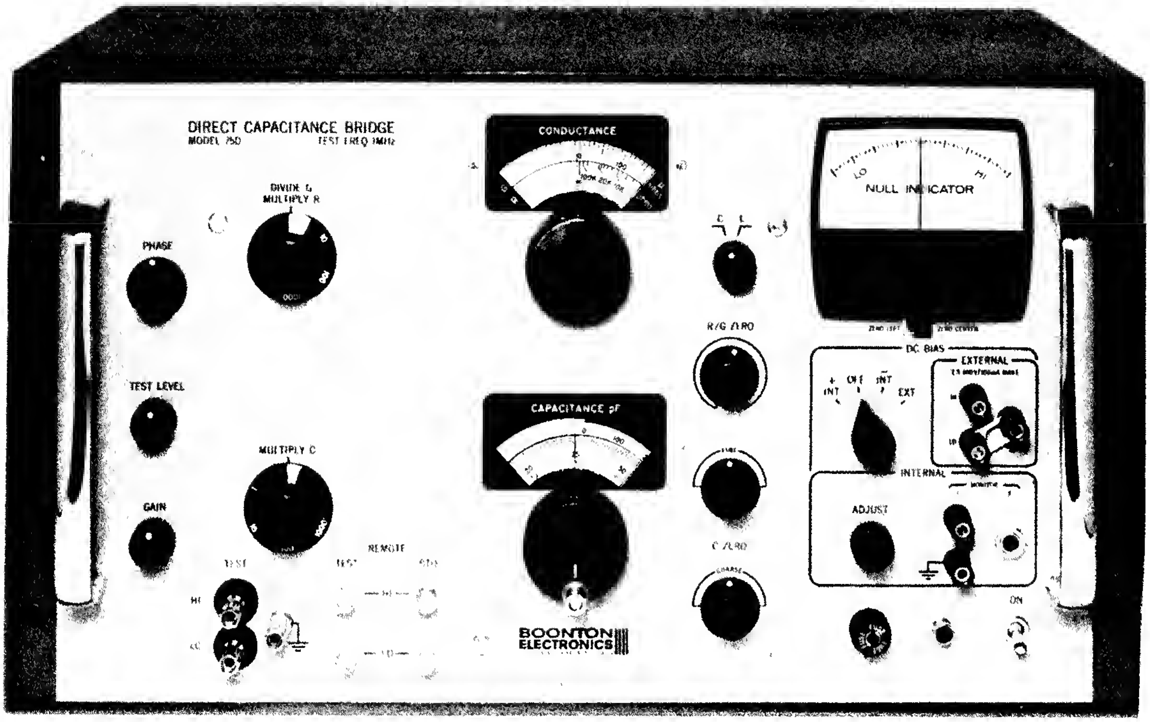

Figure 1. Direct Capacitance Bridge, Model 75D, (1 MHz)

CHAPTER I

GENERAL DESCRIPTION

1.1 GENERAL. The Direct Capacitance Bridge, Model 75D, (1 MHz) is a self-contained test instrument (Figure 1) designed for use as a precision laboratory bridge to measure values of capacitors, inductors, and semiconductor devices, or to perform single-limit sorting tests of capacitive or inductive specimens.

The instrument provides direct (3-terminal) readings of parallel capacitance (C), effective parallel conductance (G), and equivalent parallel resistance (Rp). Parallel inductance (L) is measured in terms of equivalent capacitance, and dissipation (D) or Q are readily determined by a simple computation.

The Model 75D is largely insensitive to capacitance from either side of the specimen to ground and provides accurate readings even in the presence of relatively large stray capacitance. Thus, the direct capacitance of specimens is precisely measured, and a remote test jig or coaxial cables may be used to connect specimens without introducing errors due to jig capacitance or cable capacitance. Test specimens may be biased directly by the internal dc supply, or an external bias voltage may be applied through terminals on the front panel. External capacitance standards also may be connected at the front panel to check calibration or to perform comparison or differential measurements.

Other typical uses of the Model 75D are as follows:

- Measurement of the capacitance of semiconductors
- Measurement of the capacitance of varactors
- Test or measurement of capacitance elements of microcircuit chips
- Measurement of the temperature coefficient of capacitors.
- Measurement of stray circuit capacitance.
- Measurement of stray circuit capacitance

In addition, the Model 75D is used for single-limit and dual-limit testing and sorting operations of capacitors, inductors, and semiconductor devices during production testing, incoming inspection, quality assurance, and similar applications.

1.2 EQUIPMENT DESCRIPTION. The Model 75D contains, in one cabinet, a bridge, signal source, null detector, power supply and bias supply. All operating controls and indicators are mounted on the front panel. If required, the Model 75D may be removed from the cabinet and installed in a standard 19-inch rack.

A bracket is installed on the rear panel to secure the instrument's ac power cable, and a terminal shield is provided for the TEST binding posts. This serves to shield the binding posts from hand-capacitance or stray-capacitance effects when the REMOTE coaxial terminals are used to connect specimens of standards.

1.3 OPTIONAL ACCESSORIES. The accessories described in the following table are available for use with the Model 75D to increase its versatility. For additional information, call on either your nearest sales engineering representative or the Boonton Electronics Corporation.

Table I. Optional Accessories

ACCESSORY	FUNCTION
Capacitance Standards, Model CS	Transfer capacitance standards calibrated against NBS- certified reference standards. Used to calibrate or check the accuracy of 3-terminal capacitance bridges and to provide high-resolution comparison measurements. Available in any value from 0.01 to 1000-pF at 0.1% accuracy. Designed for operation from 1 kHz to 1 MHz.
Range Extender, Model 77-2A	Extends the capacitance range of the Model 75D to 0.1 μF, conductance range to 1 mho, resistance range to 1 ohm, and inductance range to 0.25 μH.
Range Divider, Model 77-4A	Divides Model 75D capacitance readings by a fixed factor of 10 and permits measurements down to 0.00001 pF.
Ground Plane Adapter, Model 75-6A	Can be used with the Model 75D to perform (if required) grounded (2-terminal) measurements or tests. When installed on the TEST binding posts, the adapter provides a ground plane that enables the (3-terminal) Model 75D to simulate 2-terminal (grounded) measurements or tests.
Dust Covers	Perforated metallic covers. Replace cabinet when the Model 75D is rack-mounted.

1.4 TECHNICAL CHARACTERISTICS. The technical characteristics of the Model 75D are shown in the following table:

TABLE 2

Technical Characteristics

a. Capacitance Measurement

Capacitance Range: 0 to 1000 pF

Capacitance Resolution and Accuracy:

MULTIPLY C Setting	Capacitance Range (pF)	Resolution		Accuracy	
		Phase Mode (pF)	Amplitude Mode(pF)	Phase Mode	Amplitude Mode
1.0	0 to 1000	0.2	0.2	$\pm(0.25 + \frac{10}{Q})\% + 0.5pF$*	$\pm 0.25\% + (1000/R_p + 0.5)pF$
0.1	0 to 100	0.02	0.02	$\pm(0.25 + \frac{3}{Q})\% + 0.05pF$	$\pm 0.25\% + (1000/R_p + 0.05)pF$
0.01	0 to 10	0.002	0.002	$\pm(0.25 + \frac{3}{Q})\% + 0.005pF$	$\pm 0.25\% + (1000/R_p + 0.005)pF$
0.001	0 to 1	0.0002	0.0005	$\pm(0.25 + \frac{3}{Q})\% + 0.001pF$	$\pm 0.25\% + (1000/R_p + 0.001)pF$
0.0001	0 to 0.1	0.00005	0.0005	$\pm(2 + \frac{10}{Q})\% + 0.00005pF$	$\pm 2\% + (1000/Rp + 0.0005)pF$

Where R_p is the equivalent parallel resistance of the specimen in ohms.

* Q must be 10 or greater.

b. Inductance Measurement

Inductance Range: 25 μH to 25 mH.

Inductance Accuracy:

MULTIPLY C Setting	Inductance Range	Accuracy	
		Phase Mode	Amplitude Mode
1.0	25 μH to 250 μH	$\pm(0.25+\frac{10}{Q}+2L)\%$*	$\pm(0.25+2L+\frac{4000L}{R_p})\%$
0.1	250 μH to 2.5 mH	$\pm(0.25+\frac{3}{Q}+\frac{L}{5})\%$	$\pm(0.25+\frac{L}{10}+\frac{4000L}{R_p})\%$
0.01	2.5 mH to 25 mH	$\pm(0.25+\frac{3}{Q}+\frac{L}{50})\%$	$\pm(0.25+\frac{L}{50}+\frac{4000L}{R_p})\%$

Where L is the inductance of the specimen in millihenries.

R_p is the equivalent parallel resistance of the specimen in ohms.

c. Conductance Measurement

Conductance Range (amplitude mode only): 0 to 1000 μmhos

Conductance Resolution and Accuracy:

DIVIDE G Setting	Conductance Range	Resolution	Accuracy
1	0 to 1000 μmhos	5 μmhos	$\pm(10+\frac{Q}{500})\%+10$ μmhos
10	0 to 100 μmhos	0.5 μmho	$\pm(5+\frac{Q}{500})\%+1$ μmho
100	0 to 10 μmhos	0.05 μmho	$\pm(5+\frac{Q}{500})\%+0.1$ μmho
1000	0 to 1 μmho	0.01 μmho	$\pm(5+\frac{Q}{500})\%+0.01$ μmho

Table 2. Technical Characteristics (cont'd.)

d. Resistance Measurement

Resistance Range (amplitude mode only)   1 kΩ to 100 MΩ

Resistance Resolution and Accuracy:

MULTIPLY R Setting	Resistance Range (ohms)	Resolution	Accuracy
1	1 K to 100 K	$(R_p/10^3)\%$	$\pm(10+Q/500+R_p/10^3)\%$
10	10 K to 1 M	$(R_p/10^4)\%$	$\pm(5+Q/500+R_p/10^4)\%$
100	100 K to 10 M	$(R_p/10^5)\%$	$\pm(5+Q/500+R_p/10^5)\%$
1000	1 M to 100 M	$(R_p/10^6)\%$	$\pm(5+Q/500+R_p/10^6)\%$

Where R_p is the equivalent parallel resistance of the specimen in ohms.

e. Test Signal

Frequency: 1 MHz (±100 Hz) crystal controlled

Level: Continuously adjustable from 250 mV to 1 mV
(250 mV to 15 mV for phase mode)

f. DC Bias

Internal: Continuously adjustable from -6 V to +150 V.

External, 2 Terminal: Up to ±400 V at 100 mA from HI post to LO post.

External, 3 Terminal: Up to ±400 V at 100 mA from HI post to ground, or from LO to ground (total potential from HI and LO posts to ground not to exceed 400 V at 100 mA.)

g. Power Requirements: 105 - 125 V, 50/60 Hz or 210 - 250 V, 50/60 Hz.

h. Power Consumption: 50 watts

Table 2. Technical Characteristics (cont'd.)

i. Dimensions:

Installed in Cabinet:	11-1/4" h x 19-1/2" w x 12-3/4" d
Cabinet Removed:	10-1/2" h x 19" w x 10-1/8" d

j. Weight:

Installed in Cabinet:	35 lbs.
Without Cabinet:	25 lbs.

1.5 THEORY OF OPERATION. The 75D Capacitance Bridge consists of three basic units: a signal source, a bridge, and an amplifier/detector with null indicator.

1.5.1 Signal Source. The signal source is a stable, crystal-controlled oscillator with a 6AU6 vacuum tube (V203) in a modified Colpitts circuit. This oscillator operates at a frequency of 1 MHz ± 100 Hz.

Two outputs are supplied by the oscillator. One, of 100 volts peak-to-peak, is used to provide the reference voltage for the phase detector; the second, of between 1 and 750 millivolts (variable), furnishes the signal source for the bridge itself.

1.5.2 Bridge. The bridge network used in the 75D is a modified Young circuit. Figure 2 shows the basic configuration of the bridge in simplified form.

The 1 MHz oscillator voltage is injected into the bridge by transformer T501. The secondary windings of this transformer are accurately balanced and tightly coupled, ensuring that the signal voltages appearing in both sides of the bridge are identical in amplitude and opposite in phase. The tight coupling between halves of the secondary, and the low impedance level, also serve to minimize the effects of external capacitance unbalance. Any unbalance appearing on one side (as, for instance, a connecting cable) is transferred equally to the other side. Thus the 75D is effectively immune to extraneous capacitance effects.

Referring to Figure 2, the two LO posts (A and B) are the signal-injection corners of the bridge, and the HI post (D) and ground (C) are the detection corners. When the bridge is balanced for capacitance and conductance (C and G), the impedances appearing between each of the LO posts and the HI post are equal. The voltages that are summed at the HI post are equal and opposite in phase; under this condition, the net voltage developed at the detector corner is zero and the null indicator will show a balance.

The Capacitance dial, calibrated in pF, controls a variable differential air capacitor of high quality and maximum stability. The dial mechanism is carefully designed to hold backlash to negligible proportions, allowing full advantage to be taken of the high resolution capabilities of the instrument. Capacitance range multiplication is accomplished by switching multiplier capacitors in series with the rotor of the main capacitor. The multiplier capacitors are precision air variables, carefully adjusted at the factory.

The Conductance control is an infinite-resolution potentiometer connected between the Standard and the Test arms of the bridge, with its rotor connected to the HI post. The range of the Conductance control is varied by switching multiplier resistors in series with the rotor arm of the potentiometer.

1.5.3 Amplifier/Detector. Although Figure 2 indicates just a detector, the 75D is actually fitted with two detectors. When both capacitance and conductance

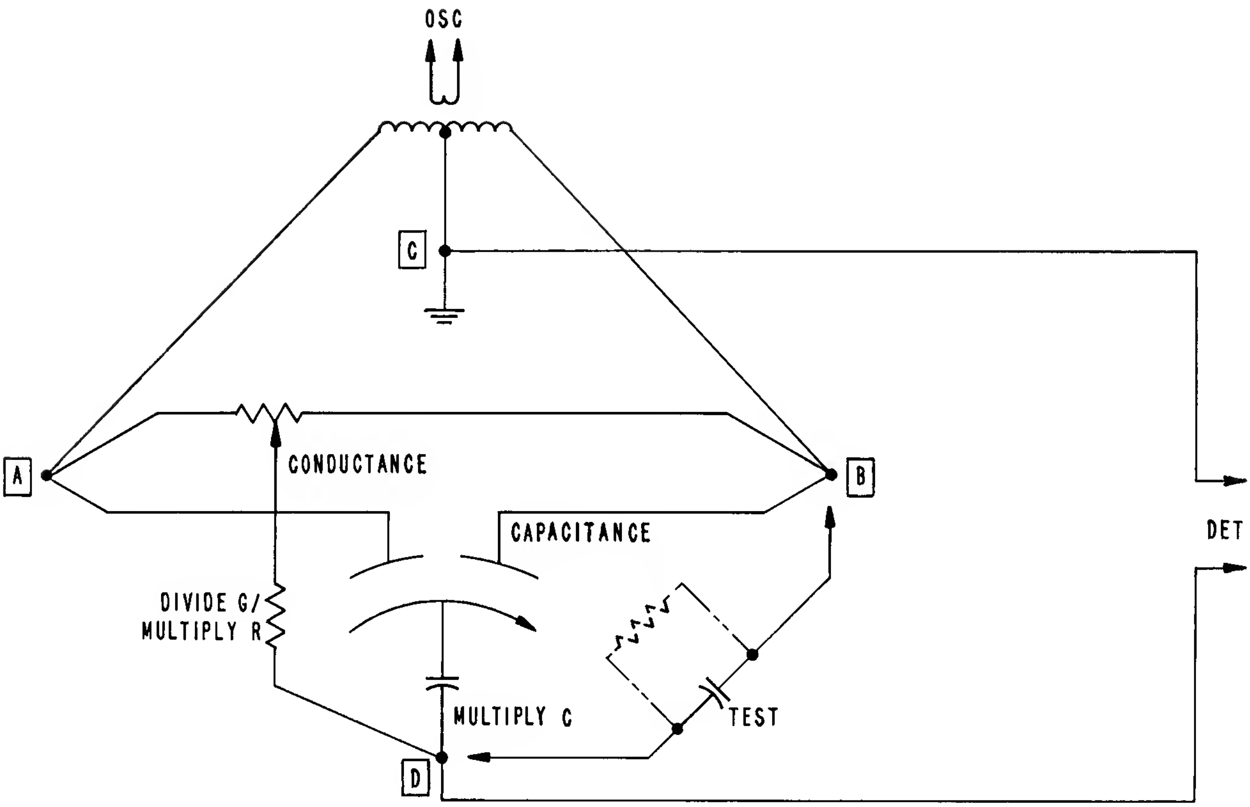

Figure 2. Basic Bridge Configuration

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of a specimen are to be measured, the indicator meter is switched to the amplitude detector. The indicator then operates with zero at the left end of the scale. When only capacitance is to be measured and conductance is to be ignored, the indicator is switched to the phase detector. In this mode, the indicator operates zero center. The mode to be used is selected by the switch just beneath the meter: ZERO LEFT for both capacitance and conductance; ZERO CENTER for capacitance alone.

Figure 3 shows the 75D in simplified block form.

The unbalance signal from the bridge is fed to the pre-amplifier stages V101 and V102. Output from the pre-amplifier is then coupled to V201 in the Oscillator-Detector section, where the signal is split into two paths. One signal path goes to the phase detector chain, while the other goes to the amplitude detector.

The amplitude detector is basically a straight amplifier circuit (V202) and a diode rectifier (CR204). The dc output of this rectifier is applied to the null indicator meter. To prevent errors and difficulties resulting from the presence of stray rf fields, oscillator harmonics and other extraneous signals, the signal input to V202 is passed through a highly-selective quartz crystal filter (Y201 - Y202). This two-section filter exhibits a passband of between 50 and 100 Hz, with very steep skirts.

Figure 4 shows, in a simplified schematic, the phase detector circuits. The 1 MHz signal resulting from a bridge unbalance is amplified and fed to the phase detector at the junction of C204, L203 and C209.
The parallel-resonant tuned circuit formed by L203, C204 and C205 causes an equal and opposite voltage to appear at the junction of C205, L203 and C210. These two voltages are applied to diodes CR202 and CR203, while the reference voltage from the oscillator is applied to the junction of these two diodes.

When the PHASE control (C107) is correctly adjusted, the input voltages to the phase detector resulting from a capacitive unbalance are set so that one is in phase with the reference voltage and the other is 180° out of phase with it.

The input voltages resulting from a conductance unbalance, on the other hand, are such that one leads the reference voltage by 90° and the other lags by 90°.

The input voltages are combined vectorially with the reference voltage in the phase detector. For the condition of a capacitive unbalance in the bridge, one input (in phase wih the reference voltage) adds to the reference vector, while the other input (180° out of phase with the reference voltage) subtracts from the reference vector. These voltages are combined and rectified by CR202 and CR203. The resultant dc outputs are such that one becomes less negative, while the other becomes more negative. These dc voltages are applied to the grids of the dual-triode dc amplifier V301. As the dc grid potentials under these conditions are not equal, there is a resultant change in the anode current which deflects the null indicator accordingly.

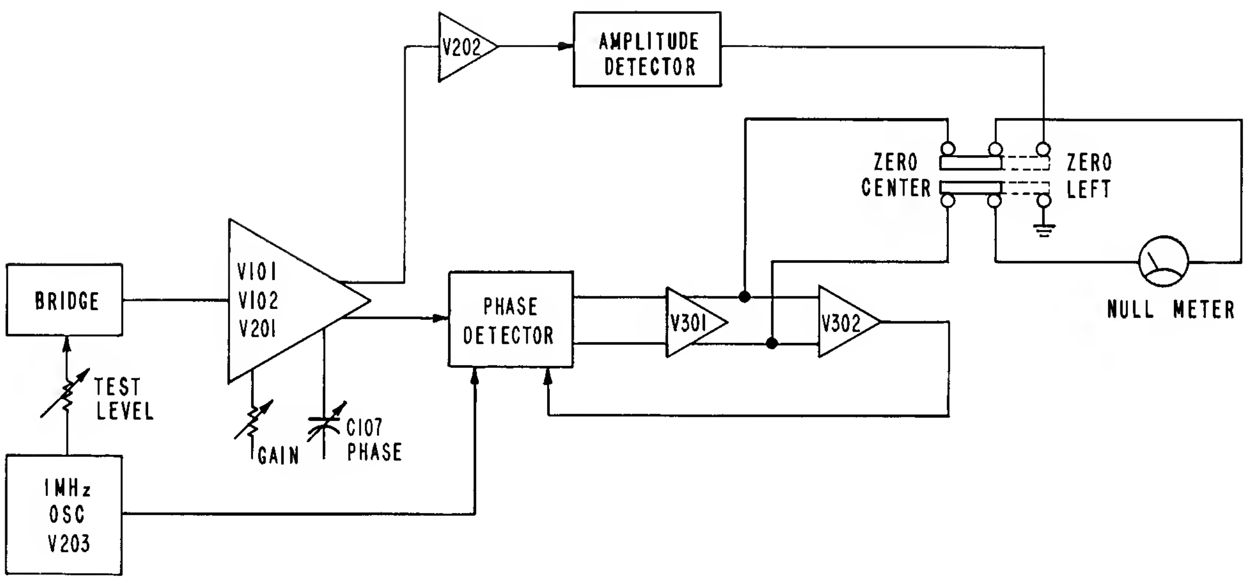


Figure 3. Model 75D Block Diagram

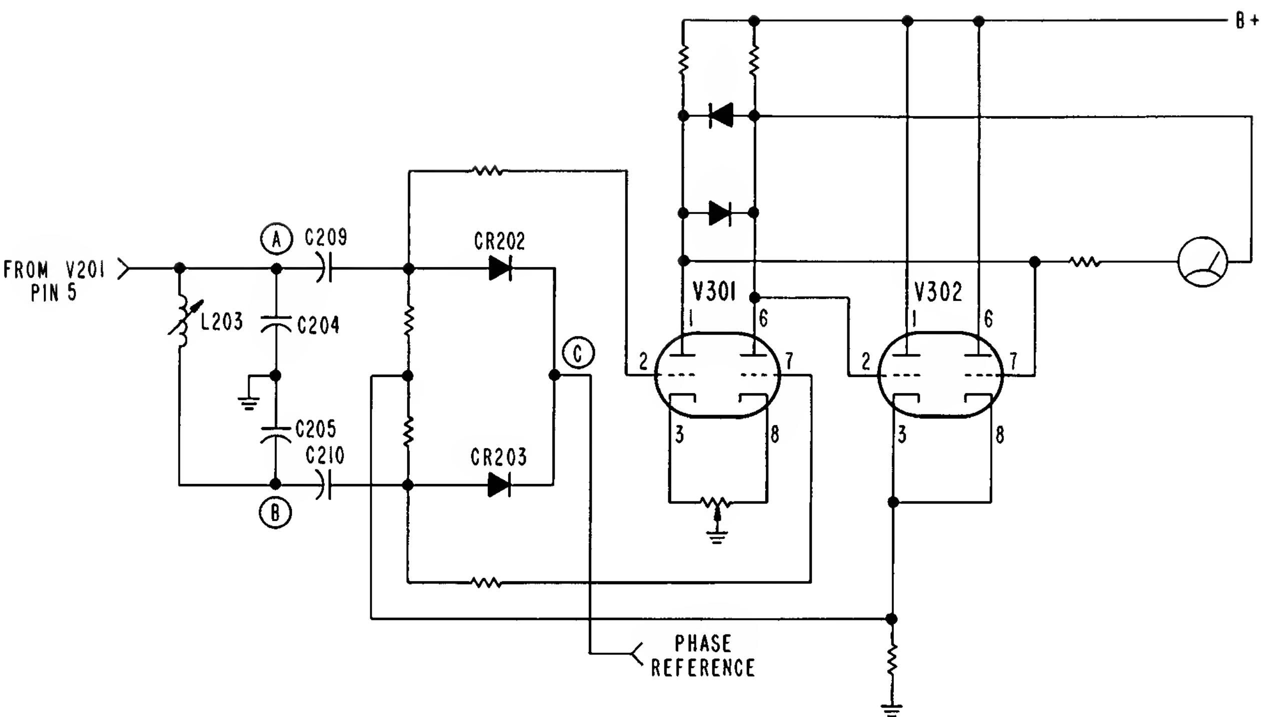
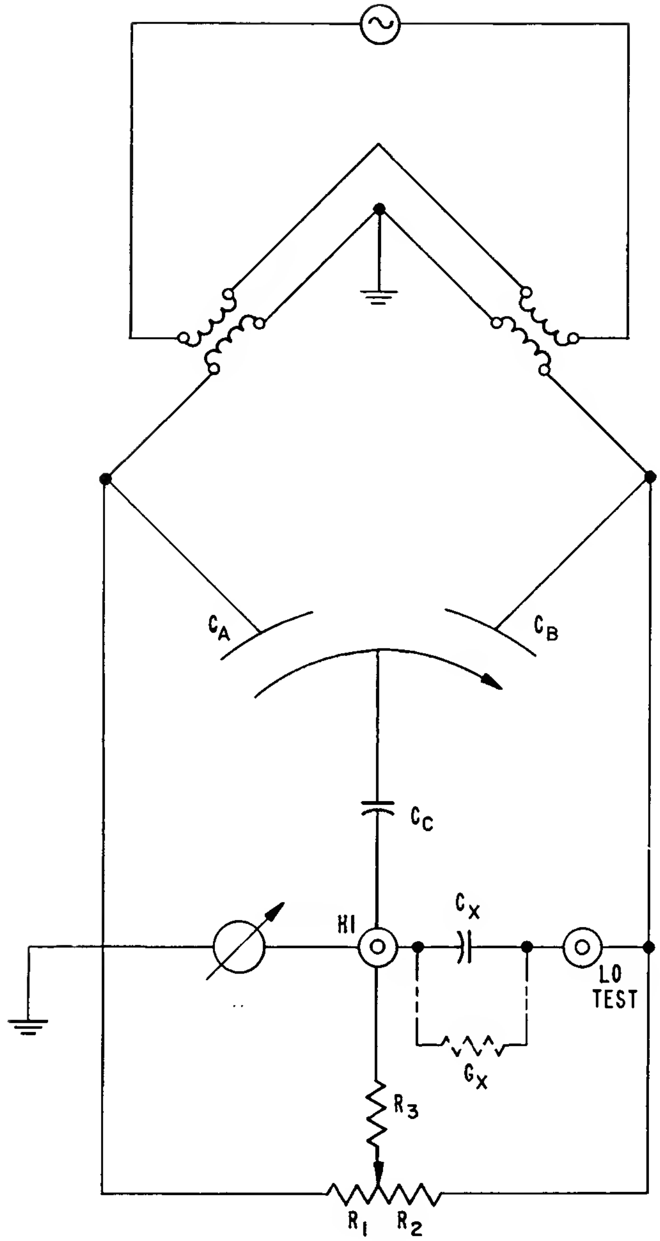


Figure 4. Model 75D Phase Detector (Simplified Schematic)

When an unbalance exists in conductance, the vector addition results in both of the rectified voltages becoming slightly less negative, and by the same amount. The resultant dc voltages applied to the grids of V301 are therefore of equal value, and no change occurs in the anode circuit as a result. Thus, using the phase detector (ZERO CENTER), the bridge can be balanced for capacitance regardless of differences in conductance.

Figure 5 illustrates the basic bridge equations.



$C_x = \left[(C_a - C_b)/(C_a + C_b)\right]/C_c + 1$

$G_x = (R_2 - R_1)/\left[R_1 R_2 + R_3 (R_1 - R_2)\right]$

Figure 5. Basic Bridge Equations

CHAPTER II

INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 Unpacking. The instrument is supported in the carton by the notches in the four corner cylinders of plastic foam material. After opening the top of the carton, take hold of the two front panel handles through the plastic covering and slowly pull the instrument up out of the carton. Remove the plastic covering from the cabinet and strip off the plastic sleeves from the handles. See that any accessories ordered have been included in the shipment. It is strongly recommended that the carton and all packing material be carefully saved for possible reshipment in the future.

2.1.2 Inspection. Once the instrument is out of its carton, it should be inspected for any signs of physical damage resulting from shipment. If any damage is found, be sure to notify the carrier immediately. When the instrument has been found to be in good order mechanically, its electrical performance should be checked. This should be done by following the Equipment Performance Checklist, Table 5, in Chapter IV. Should the bridge show evidence of a malfunction during this test, notify your local Boonton representative or the Boonton Electronics Corporation directly.

2.2 PACKING FOR RESHIPMENT

If, for any reason, it becomes necessary to return the instrument to the factory, the company should be notified before shipping. Please follow these special packing instructions:

a. If possible, use the original shipping carton and packing material.

b. Secure the ac power cable around its bracket on the rear panel.

c. Include any accessories.

d. Tie a tag or envelope to a front-panel handle with the following data:

1. Name and address of purchaser.
2. Model and serial number.
3. Full description of damage or defect.

2.3 POWER CONNECTIONS

Make certain that the available power source agrees with the voltage and line frequency specified on the identification plate, and plug the cable into a power receptacle. The instrument is furnished for either 105-125 volts, 50-60 Hz, or 210-250 volts, 50-60 Hz.

2.4 RACK INSTALLATION

a. Remove the four screws at the sides of the front panel and take off the two edge strips.

b. Grasp the two front-panel handles and carefully slide the unit out of the cabinet; feed the power cable through the cutout of the rear panel, and remove the cabinet.

c. Installation of dust covers (Part Nos. 600228 and 600229) is strongly recommended. These are mounted as follows:

   1. Feed the power cable through the cutout in the lower dust cover.
   2. Fasten the lower cover to the chassis bottom with six No. 6 self-tapping screws 1/4" long.
   3. Use eight No. 6 self-tapping 1/4" screws to fasten the upper dust cover.
   4. Unscrew the nameplate from the rear of the cabinet and fasten it to the rear of the upper dust cover.

d. Install the Model 75D in the rack and secure with panel screws.

e. Connect the power cable to an ac power receptacle.

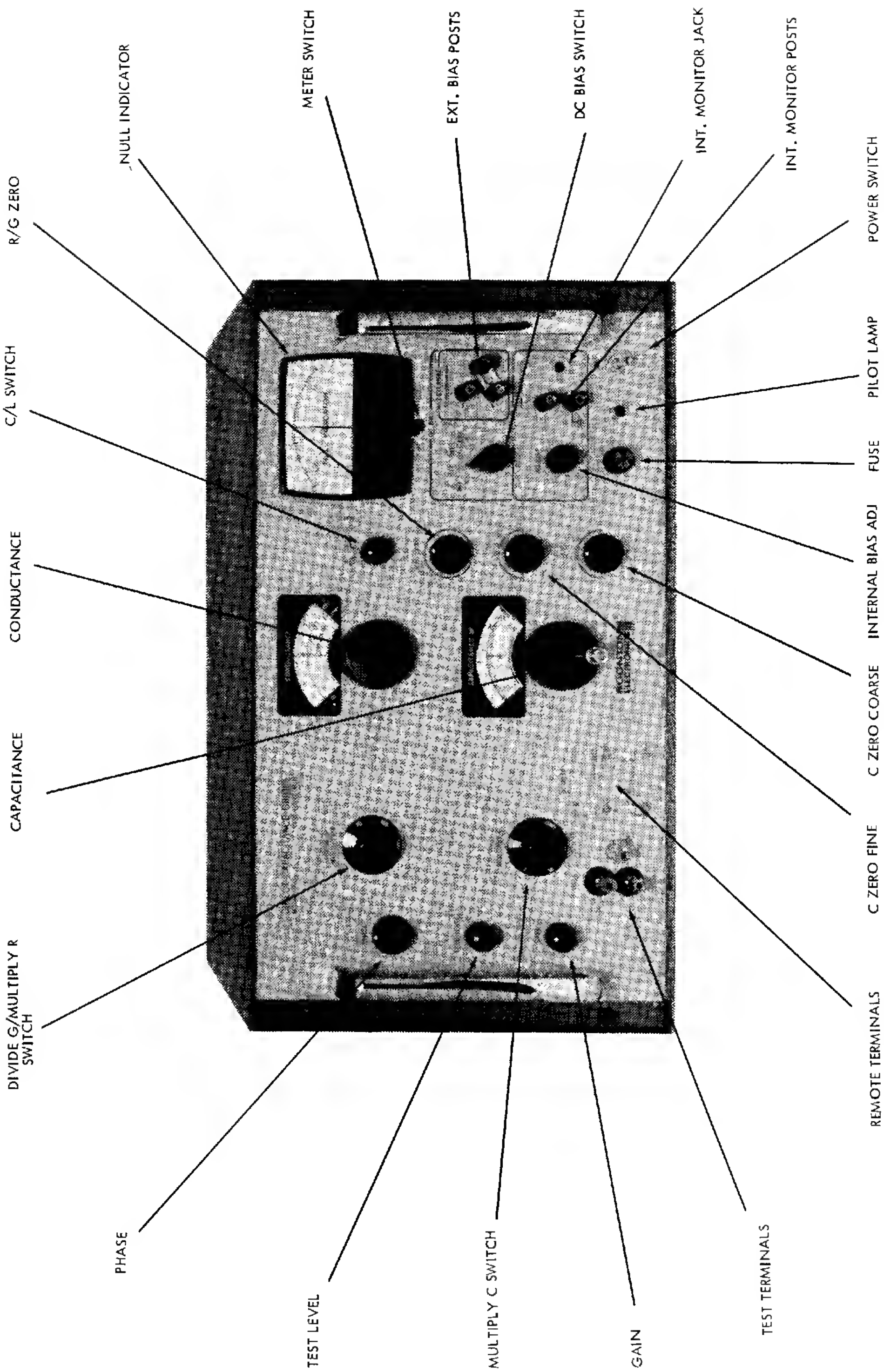


Figure 6. Capacitance Bridge, Model 75D Controls and Indicators

CHAPTER 3

OPERATION

3.1 GENERAL. Before performing any measurements or tests observe the instructions in Part 1 Preliminary Operating Instructions, of this chapter, and thoroughly review the function of each control and indicator. During operation, refer to the applicable equation in paragraph 1.4 for accuracy information, especially when measuring or testing low-Q specimens.

PART 1. PRELIMINARY OPERATING INSTRUCTIONS

3.2 CONTROLS AND INDICATORS. All operating controls and indicators on the Model 75D are described in the following table. Reference designations are provided to facilitate the identification of each item when referring to the schematic diagram. Complete familiarity with the control and indicator functions is recommended before operation of the instrument is attempted.

Table 3. Controls and Indicators

COMPONENT	DESCRIPTION - FUNCTION
CAPACITANCE control (C311)	Bridge balancing variable capacitor used to measure capacitance. Two-section dial reads capacitance in pF. Upper dial section is calibrated in increments of 100 with the left half of each increment coded black and the right half coded red. The lower section vernier dial consists of two concentric scales calibrated in increments of 5 which contain unit graduations with 1/5 sub-divisions. Black numbers on the vernier dial complement the readings obtained on the black-coded region of the upper dial. Red numbers on the vernier dial complement the readings obtained on the red-coded region of the upper dial.
MULTIPLY C switch (S301)	Rotary switch with five capacitive decade positions. Used with the CAPACITANCE control (above) whose reading is multiplied by the MULTIPLY C factor. Serves to expand the CAPACITANCE dial and to facilitate fractional pF measurements.

Table 3. Controls and Indicator (Cont'd)

COMPONENT	DESCRIPTION - FUNCTION
C ZERO COARSE and FINE controls (C302) and (C301)	Correlated variable capacitors. Used to set up the Model 75D for operation by balancing the capacitive portion of the bridge network (with CAPACITANCE dial set at zero).
CONDUCTANCE control (R308)	Continuously variable resistor. Initially set at zero when bridge is being balanced. Dual-scale dial provides direct readings of test specimen's parallel conductance and equivalent parallel resistance. Conductance (G) scale calibrated in µmhos, and resistance (R) scale calibrated in ohms.
DIVIDE G/MULTIPLY R switch (S302)	Rotary switch with 4 resistive decade positions. Extends the range of the CONDUCTANCE control by using the switch factor to divide the CONDUCTANCE G-scale reading and to multiply the R-scale reading.
R/G ZERO control (R310)	Variable resistor. Used to balance the resistive portion of the bridge network (with the CONDUCTANCE dial set at zero).
TEST LEVEL control (R305)	Variable resistor. Provides continuous control of test-signal level from 1 mV (fully counterclockwise) to 250 mV (fully clockwise).
GAIN control (R139)	Variable resistor. Used to control gain for both the phase detector and the amplitude detector. Fully clockwise position provides maximum gain.
PHASE control (C108)	Continuously variable capacitor. Provides the proper phase relationship between reference and test signals so that the phase detector is insensitive to test specimen losses.

Table 3. Controls and Indicator (Cont'd)

COMPONENT	DESCRIPTION - FUNCTION
C/L switch (S303)	Two-position rotary switch. Normally, the C position is used for capacitance measurements and tests, and the L position is used for inductance measurements and tests. However, the normal switch positions are reversed temporarily during phase adjustments (paragraphs 3.9, 3.10, 3.12, 3.13) whenever the MULTIPLY C switch is in the 1 position.
NULL INDICATOR (M101)	Meter indicator. Continuously monitors the output of the bridge circuit. The meter circuit is either amplitude-sensitive or phase-sensitive in accordance with the position of the meter switch (below).
Meter switch (S101)	Two-position slide switch used in conjunction with the NULL INDICATOR. <u>ZERO LEFT position:</u> Connects the NULL INDICATOR to the amplitude detector, and the meter is sensitive to both C and G. Meter zero is the extreme left marking on the LO sector of the meter scale. <u>ZERO CENTER position:</u> Connects the NULL INDICATOR to the phase detector, and the meter is sensitive to C while ignoring G. Meter sensitivity is increased by a factor of 10. Meter zero is the midscale marking; therefore, a zero-balance indication for the ZERO CENTER position should be at midscale. If the bridge circuit is unbalanced, the meter indicates whether the imbalance is caused by LO or a HI capacitance.

Table 3. Controls and Indicator (Cont'd)

COMPONENT	DESCRIPTION - FUNCTION
DC BIAS: switch (S201)	Four-position rotary switch used to select the following bias voltages: +INT: Internal bias up to +150 volts. OFF: Disables internal bias supply. -INT: Internal bias up to -6 volts. EXT: Disables internal bias supply and connects the bridge to the EXTERNAL binding posts.
EXTERNAL HI, LO, and ⏚ binding posts	Used to connect external bias (up to 400V at 100 mA, maximum). A jumper is installed between the LO and ground terminals for 2-terminal bias applications. The jumper is removed for 3-terminal bias applications to permit independent biasing at the HI and LO posts. The EXTERNAL HI, LO, and ground binding posts are dc extensions of the corresponding TEST and REMOTE TEST terminals on the front panel.
INTERNAL ADJUST control (R201)	Variable resistor. The 10-revolution control knob adjusts internal bias levels from -6V to +150V when the DC BIAS switch is in the +INT or -INT position.
INTERNAL MONITOR E and ⏚ binding posts	Terminals used to connect a dc volt-meter for metering internal bias voltage.
INTERNAL MONITOR jack (J201)	Normal-through jack with make-before-break contacts; used to connect a meter for measuring internal bias current.
Power switch (S401)	Toggle switch. Controls the application of ac power to the instrument.

Table 3. Controls and Indicators (Cont'd)

COMPONENT	DESCRIPTION - FUNCTION
Pilot lamp (PL401)	Lamp indicator. Glows when ac power is applied to the instrument.
Fuse (F401)	Protects equipment against overloads. (Slo-Blo - 0.5A at 250V)
TEST binding posts	Test terminals used to connect capacitive specimens. TEST HI and LO binding posts used for two-terminal specimens, and TEST HI, LO, ⏚ used for three-terminal specimens. The TEST HI and LO binding posts are terminals in the test arm of the bridge, and the ⏚ binding post is at chassis ground.
REMOTE TEST coaxial connectors (J303) (J304)	BNC test terminals used to connect capacitive specimens. The REMOTE TEST HI and LO inner conductors are in parallel with the corresponding TEST HI and LO binding posts (above), and the BNC outer conductors are at chassis ground.
REMOTE STD coaxial connectors (J301) (J302)	BNC test terminals used to connect inductive specimens as well as external standards or balancing capacitors. The REMOTE STD HI and LO inner conductors are terminals in the standard arm of the bridge, and the BNC outer conductors are at chassis ground.
Ac power connector (P401)	Three-terminal plug connected to a power cable. Connects the instrument to an ac power source.

3.3 STARTING PROCEDURE. Set the power switch to ON. If the Model 75D is to be operated in the amplitude mode, allow 15 minutes for warm-up. For phase-mode operation, allow one hour warm-up to ensure thermal stabilization of the phase detector circuit.

3.4 INITIAL SWITCH AND CONTROL SETTINGS. Set the various switches and controls on the front panel of the Model 75D in accordance with the following table.

Table 4. Initial Switch and Control Settings

COMPONENT	SETTING OR POSITION
CAPACITANCE main dial and vernier dial	0
CONDUCTANCE G-scale dial	0
MULTIPLY C switch	Set to appropriate range
DIVIDE G/MULTIPLY R switch	Set to appropriate range
R/G ZERO control	12 o'clock
C ZERO FINE and COARSE controls	12 o'clock
C/L switch	C
TEST LEVEL control	Fully clockwise (See Par. 3.5.1)
GAIN control	Fully clockwise (See Par. 3.5.2)
PHASE control	12 o'clock
Meter switch	ZERO LEFT
DC BIAS switch	OFF (See Par. 3.5.3)
DC BIAS INTERNAL ADJUST control	Fully counterclockwise
Terminal shield	Installed on TEST binding posts

3.5 ZERO-BALANCING THE BRIDGE. The zero-balance procedure is a basic operation that is performed during each measurement and test procedure in this chapter. Therefore, familiarization with zero-balancing is recommended before proceeding with the measurements or tests. During operation, any of the following conditions will require zero-balancing the bridge:

a. The setting of the MULTIPLY C switch is changed.
b. The setting of the DIVIDE G/MULTIPLY R switch is changed.
c. The setting of the C/L switch is changed.
d. The position of the GAIN control is changed.
e. The position of the TEST LEVEL control is changed.
f. Test leads, cables, or a test jig are connected to the Model 75D.
g. When either the terminal shield or the ground plane adapter installed on the TEST binding posts is removed.

Before starting the zero-balancing process which follows, check that no test specimen is connected to the Model 75D and note the following definitions of a null indication and a complete null: A <u>null indication</u> is defined as minimum meter reading. For a <u>complete null</u>, the meter pointer must be within one subdivision of zero when the MULTIPLY C switch is at any position except 1. When the MULTIPLY C switch is at 1, the meter pointer must be within three subdivisions of zero for a complete null. Proceed with the following steps to zero balance the bridge.

a. Adjust the C ZERO COARSE control for a null indication on the meter.
b. Adjust the C ZERO FINE control for a null indication.
c. Adjust the R/G ZERO control for a null indication.
d. Repeat steps b and c until a complete null is obtained.

NOTE

Whenever the DIVIDE G/MULTIPLY R switch is in the 1 position, adjust the CONDUCTANCE control for a null indication before performing steps a through d above.

3.5.1 TEST LEVEL control: This control adjusts the oscillator voltage applied to the bridge and, of course, to the specimen being measured; this voltage can be varied over the range of 1 mV to approximately 300 mV. When measuring semiconductor devices with zero bias, a low test level is necessary so the excursion on the V-I characteristic is confined to small enough a section to be considered nearly linear. That is, an increase in the test level should not cause a significant change in the measured capacitance.

The signal voltage applied to the specimen can easily be measured at the front panel with an RF Millivoltmeter such as the Boonton Model 92 Series. The probe of the voltmeter is plugged into the LO TEST coaxial jack and the TEST LEVEL control varied to obtain the correct voltage. The millivoltmeter can then be removed and the specimen connected.

NOTE: When the TEST LEVEL control has been adjusted, the bridge must be rebalanced before making any measurements.

If it is desired to monitor the applied voltage continuously, the Millivoltmeter can be permanently connected by using a Tee adapter. Presence of the probe does not affect bridge operation.

3.5.2 GAIN control: This adjusts the gain of the first amplifier stage, V101, over a range of approximately 26 dB. When this control is set at a maximum, as called for in Table 4, Initial Switch and Control Settings, the instrument is operating at its maximum resolution capability and the balancing process can be rather tedious. On the high-capacity ranges, at least, the resolution afforded at this setting is really more than is needed. In these circumstances, it will be found that a balance is easier to reach if the GAIN control is turned down a bit, as the resolution varies almost directly as the gain. The optimum setting of the GAIN control is best determined experimentally by the operator to suit the nature of the measurements being made.

3.5.3 BIAS arrangements: Many semiconductor devices, such as transistors and voltage-variable capacitors, must be measured with normal dc bias applied. The 75D includes an adjustable internal bias supply with a range of -6 volts to +150 volts, controlled by the panel BIAS ADJUST control. These bias voltages appear accross the HI and Ground posts of the front panel. The polarity can be switched by the DC BIAS switch.

The bias voltage and current applied to a specimen can be measured at the front panel. A dc voltmeter can be connected across the E posts, and a dc milliameter can be plugged into the I jack on the BIAS panel. A current-limiting resistor is part of the bias circuits.

When higher bias voltages than those provided are needed, an external bias source may be used. This voltage can be up to 400 volts, with a maximum current of 100 mA., and can be either positive or negative with respect to ground. Measurement of this voltage and current must be made externally; a protective fuse or current-limiting resistor should also be included in the external bias supply to protect the bridge components.

For three-terminal biasing arrangements, two external supplies are needed. This would be useful for measurements on transistors with normal bias applied. The link from EXTERNAL HI to Ground is removed, and the two power supplies are connected to BIAS HI and ground, and BIAS LO and ground.

PART II. AMPLITUDE-MODE MEASUREMENTS

3.6 GENERAL: Use the amplitude mode of operation to measure the C, G, Rp, Q, or D of capacitive specimens or the L, G, Rp, Q or D of inductive specimens. When reading values on the CAPACITANCE or CONDUCTANCE dials during the following procedures, apply the associated MULTIPLY C or DIVIDE G/MULTIPLY R factor to the reading. (If the ground-plane adapter is being used, Step b of paragraph 3.6.1 is disregarded.)

3.6.1 C, G, Rp, Q and D Measurements.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with the table in paragraph 3.4.

NOTE:

Allow 15 minutes for warm-up after energizing the instrument.

b. If the test specimen is to be connected directly to the TEST binding posts, remove the terminal shield. If coaxial test leads or a test jig is to be used, connect the leads or jig to the REMOTE TEST coaxial connectors. (Disregard this step if the ground-plane adapter is being used.)

c. Determine the approximate capacitance value of the test specimen and set the MULTIPLY C switch as indicated in the chart below.

APPROXIMATE VALUE OF TEST SPECIMEN (pF)	MULTIPLY C SWITCH SETTING
100 to 1000	1
10 to 100	0.1
1 to 10	0.01
0.1 to 1	0.001
0 to 0.1	0.0001

d. Zero-balance the bridge in accordance with the procedure in paragraph 3.5.
e. Connect the test specimen either to the TEST binding posts (use the HI and LO posts for 2-terminal specimens and the HI, LO, and ⏚ posts for 3-terminal specimens) or to the test jig or test leads, as required.
f. Advance the CAPACITANCE control for a null indication on the meter.
g. Advance the CONDUCTANCE control for a null indication on the meter.

NOTE:

If the meter does not null, set the DIVIDE G/MULTIPLY R switch to successively lower positions and adjust the CONDUCTANCE control until a null is reached. Then remove the specimen, set the CAPACITANCE and CONDUCTANCE controls at zero, and repeat Steps d thru g.

h. Repeat Steps f and g until a complete null is reached.
i. Read the capacitance of the test specimen on the CAPACITANCE dial.
j. Read the conductance of the test specimen on the G-scale of the CONDUCTANCE dial. If the MULTIPLY C switch is in the 1 position, correct the conductance reading in accordance with Figure 8. If the DIVIDE G/MULTIPLY R switch is in the 1 position, correct the conductance reading in accordance with Figure 9.
k. Read the equivalent parallel resistance of the test specimen on the R-scale of CONDUCTANCE dial. However, if a conductance correction was made in Step j, relate the R-scale reading to the corrected G value.

l. If required, calculate the Q of the test specimen by using either the following equation or the nomograph at the conclusion of this chapter.

$$Q = 6.28C/G$$

where C = capacitance in pF

G = conductance in µmhos

m. If required, calculate the D of the test specimen by using either of the following equations or the nomograph, Figure 6, at the conclusion of this chapter.

$$D = 1/Q, \text{ or}$$

$$D = 0.159G/C$$

where C = capacitance in pF

G = conductance in µmhos

3.6.2 L, G, Rp, Q AND D MEASUREMENTS. In this procedure, the inductance of the specimen is measured in terms of equivalent capacitance, which then is translated to an inductance value by simple computation.

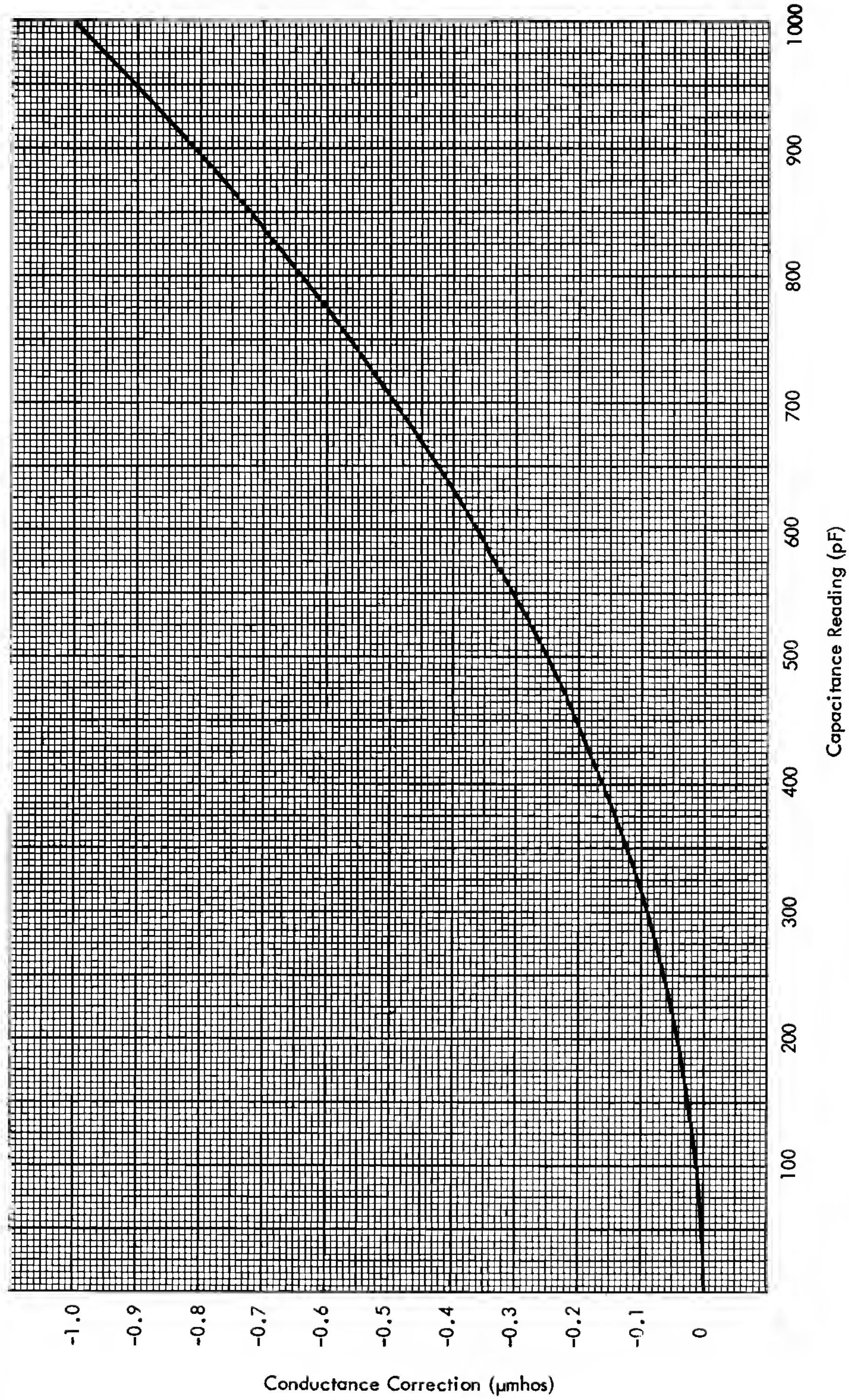


Figure 7. Conductance Correction for MULTIPLY C X1 Range

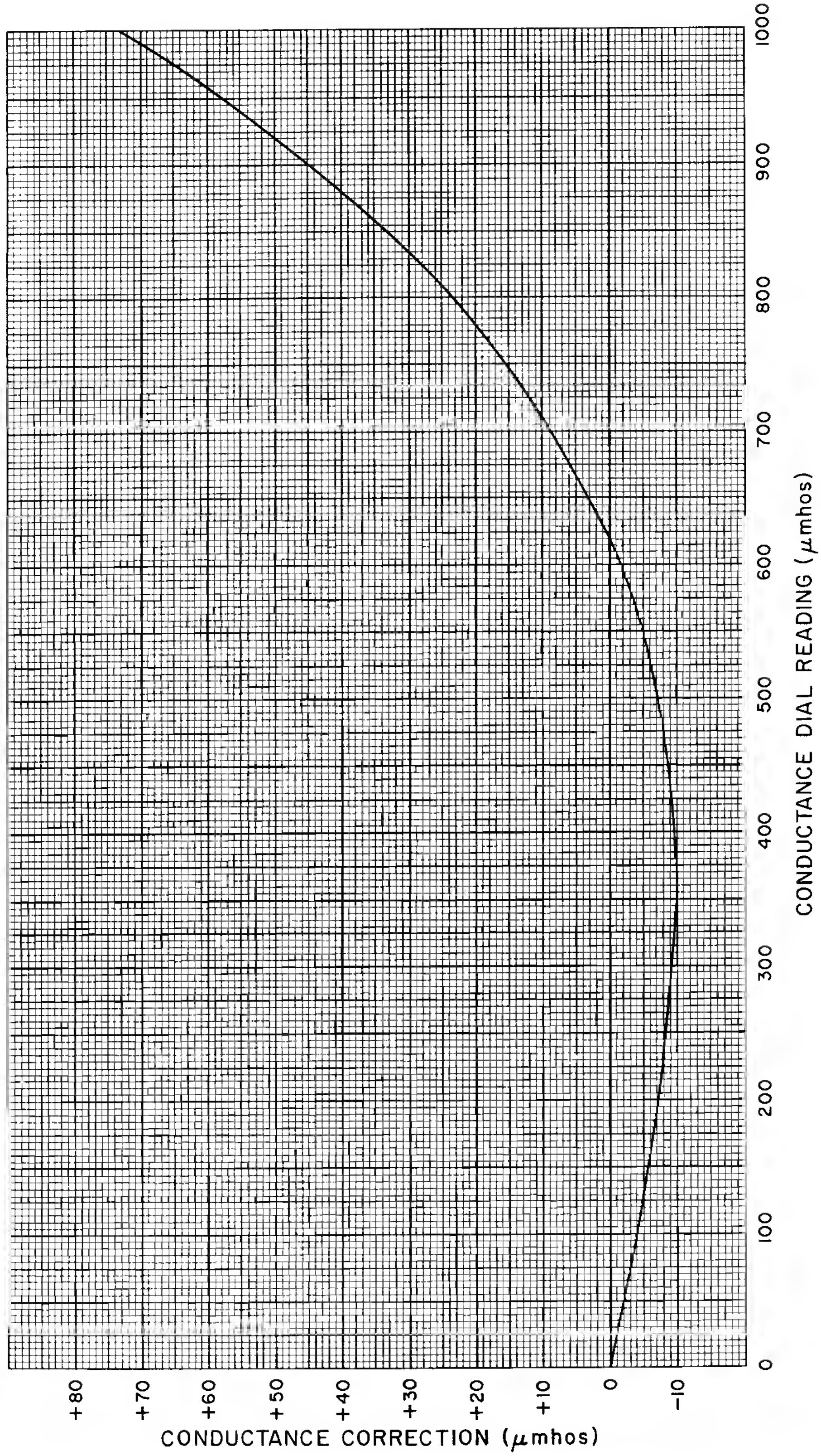


Figure 8. Conductance Correction for DIVIDE G/MULTIPLY R X1 Range

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.
b. If coaxial test leads or a test jig is to be used, connect the component to the REMOTE STD coaxial connectors.

NOTE:

The inductance of the test leads will be included in the measurement.

c. Determine the approximate inductance of the test specimen and set the MULTIPLY C switch as indicated in the following chart.

APPROXIMATE VALUE OF TEST SPECIMEN	MULTIPLY C SWITCH SETTING
25 μH to 250 μH 250 μH to 2.5 mH 2.5 mH to 25 mH	1 0.1 0.01

d. Set the C/L switch to the L position.
e. Zero balance the bridge as described in paragraph 3.5.
f. Connect the test specimen to the REMOTE STD coaxial connectors (or to the test jig or test leads, if used).
g. Advance the CAPACITANCE control for a null indication on the meter.
h. Advance the CONDUCTANCE control for a null indication on the meter.

NOTE:

If the meter does not null, set the DIVIDE G/MULTIPLY R switch to successively lower positions and adjust the CONDUCTANCE control until a null is reached. Then remove the specimen, set the CAPACITANCE and CONDUCTANCE controls at zero, and repeat Steps e thru h.

i. Repeat Steps g and h until a complete null is reached.
j. Read the value on the CAPACITANCE dial and use the following equation to convert the capacitance reading to an inductance value:

$$L = 25.33/C$$

where L = inductance in mH

C = CAPACITANCE dial reading in pF

k. Read the conductance of the test specimen on the G-scale of the CONDUCTANCE dial. If the MULTIPLY C switch is in the 1 position, correct the conductance reading in accordance with Figure 4. If the DIVIDE G/MULTIPLY R switch is in the 1 position, correct the conductance in accordance with Figure 5.
l. Read the equivalent parallel resistance of the test specimen on the R-scale

of the CONDUCTANCE dial. However, if a conductance correction was made in Step k, relate the R-scale reading to the corrected G value.

m. The Q of the test specimen may be calculated by the equation:

$$Q = 159/LG$$

where L = inductance in mH

G = conductance in μmhos

n. If required, calculate the D of the test specimen by using the following equation:

$$D = 0.00628LG$$

where L = inductance in mH

G = conductance in μmhos

PART III. PHASE-MODE MEASUREMENTS

3.7 GENERAL. Use the phase mode of operation to measure C or L when an Rp, G, Q or D measurement is not required. The following procedures respectively measure capacitance and inductance by phasing out the resistive component introduced by the test specimen so that the meter is insensitive to loss. When reading values on the CAPACITANCE dial during the following procedures, apply the MULTIPLY C factor to the reading. (If the ground-plane adapter is being used, disregard Step b of paragraph 3.10.)

3.7.1 CAPACITANCE MEASUREMENTS ONLY

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow one hour warm-up to ensure thermal stabilization of the phase detector circuit.

b. If the test specimen is to be connected directly to the TEST binding posts, remove the terminal shield. If a test jig or coaxial test leads are to be used, connect the jig or leads to the REMOTE TEST coaxial connectors. (Disregard this step if the ground-plane adapter is being used.)

c. Determine the approximate capacitance value of the test specimen and set the MULTIPLY C, DIVIDE G/MULTIPLY R, and C/L switches to the positions indicated in the chart below. (Do not adjust the CONDUCTANCE control.)

APPROXIMATE VALUE OF TEST SPECIMEN (pF)	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
100 to 1000	1	1	L	+1000
10 to 100	0.1	1	C	-100*
1 to 10	0.01	10	C	-100*
0.1 to 1	0.001	100	C	-100*
0 to 0.1	0.0001	1000	C	-100*

* Tenth (red) subdivision on G-scale to the left of zero.

d. Zero-balance the bridge as described in paragraph 3.5.
e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
f. Refer to the chart in Step c, above, and set the CONDUCTANCE control to the required position.
g. Adjust the PHASE control until the meter needle is at midscale.
h. Return the CONDUCTANCE control to zero on the G-scale.
i. If the C/L switch is at C, proceed to Step l. If the C/L switch is at L, set it to the C position.
j. Set the meter switch to ZERO LEFT and zero-balance the bridge as described in paragraph 3.5.
k. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
l. Connect the test specimen either to the TEST binding posts (use the HI and LO posts for 2-terminal specimens and the HI, LO, ⏚ posts for 3-terminal specimens) or to the test jig or test leads, as required.
m. Advance the CAPACITANCE control for an exact midscale indication on the meter.
n. Read the capacitance of the test specimen on the CAPACITANCE dial.

3.7.2 INDUCTANCE MEASUREMENTS ONLY. The inductance of the test specimen is measured in terms of equivalent capacitance, which then is translated to an inductance value by simple computation.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow one hour warm-up to insure thermal stabilation of the phase detector circuit.

b. If coaxial test leads or a test jig is to be used, connect the item to the REMOTE STD coaxial connectors.

NOTE:

The inductance of the test leads will be included in the measurement.

c. Determine the approximate inductance value of the test specimen and set the MULTIPLY C, DIVIDE G/MULTIPLY R, and C/L switches to the positions indicated in the chart below. (Do not adjust the CONDUCTANCE control.)

APPROXIMATE VALUE OF TEST SPECIMEN	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
25 μH to 250 μH	1	1	C	+1000
250 μH to 2.5 mH	0.1	1	L	-100*
2.5 mH to 25 mH	0.01	10	L	-100*

* Tenth (red) subdivision on G-scale to the left of zero.

d. Zero-balance the bridge as described in paragraph 3.5.
e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
f. Refer to the chart in Step c, above, and set the CONDUCTANCE control to the required position.
g. Adjust the PHASE control until the meter needle is exactly at midscale.
h. Return the CONDUCTANCE control to zero on the G-scale.

i. If the C/L switch is at L, proceed to Step l. If the C/L switch is at C, set it to the L position.
j. Set the meter switch to ZERO LEFT and zero balance the bridge as described in paragraph 3.5.
k. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
l. Connect the test specimen to the REMOTE STD coaxial connectors (or to the test jig or test leads, if used.)
m. Advance the CAPACITANCE control for an exact midscale indication on the meter.
n. Read the value on the CAPACITANCE dial and convert the value to inductance using the following equation:

$$L = 25.33/C$$

where L = inductance in mH

C = CAPACITANCE dial reading in pF.

PART IV. SINGLE-LIMIT TESTING

3.8 GENERAL. The single-limit testing mode of operation can be used for testing and sorting operations of capacitors, inductors, and semiconductor devices during production testing, incoming inspection, quality assurance, and similar applications. Normally, either a test jig or coaxial test leads are used to connect specimens to the Model 75D to facilitate testing. If feasible, however, test specimens may be connected directly to the front-panel terminals.

3.8.1 SINGLE-LIMIT CAPACITANCE TEST. The Model 75D is used in the following procedure to perform go/no-go tests of capacitive specimens that are to be sorted. In this test, the Model 75D compares the capacitance of each specimen with either an upper-limit value or a lower-limit value that has been programmed into the instrument, and a go or no-go readout indicates the test result. Although the Model 75D can be programmed for only one limit, dual-limit tests may be performed by repeating the procedure for the other limit. (If the ground-plane adapter is being used, disregard Step b, below.)

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.
b. If test specimens are to be connected directly to the Model 75D, remove the terminal shield from the TEST binding posts. If coaxial test leads or a test jig is to be used, connect the item to the REMOTE TEST coaxial connectors. (Disregard this step if the ground-plane adapter is being used.)
c. Determine the required limit value and set the MULTIPLY C, DIVIDE G/MULTIPLY R, and C/L switches to the positions indicated in the chart below. (Do not adjust the CONDUCTANCE control.) If the tolerance is in percentage, convert the percentage tolerance to capacitance values and algebraically add the required tolerance to the nominal value of the specimen. (For example, a ± 5% tolerance for a nominal 100 pF capacitor converts to 5 pF and becomes 105 pF for the upper limit and 95 pF for the lower limit.)

TOLERANCE LIMIT (pF)	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
100 to 1000	1	1	L	+1000
10 to 100	0.1	1	C	-100*
1 to 10	0.01	10	C	-100*
0.1 to 1	0.001	100	C	-100*
0 to 0.1	0.0001	1000	C	-100*

*Tenth (red) subdivision on G-scale to the left of zero.

d. Zero-balance the bridge as described in paragraph 3.5.
e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
f. Refer to the chart in Step c, above, and adjust the CONDUCTANCE control to the required position.
g. Adjust the PHASE control until the meter needle is exactly at midscale.
h. Return the CONDUCTANCE control to zero on the G-scale.
i. If the C/L switch is at C, proceed to Step l. If the C/L switch is at L, set it to the C position.
j. Set the meter switch to ZERO LEFT and zero-balance the bridge as described in paragraph 3.5.
k. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
l. Advance the CAPACITANCE control to the required limit value. (For the 105 pF upper limit in the Step c example, the MULTIPLY C switch would be in the 1 position and the CAPACITANCE control would be advanced to 100 on the upper dial and to 5 on the lower dial. If the lower limit were required, the CAPACITANCE control would be advanced to 95 on the lower dial.)
m. The Model 75D now is programmed to perform single-limit, go/no-go tests. Sequentially connect the capacitive specimens to the test jig, coaxial test leads, or the TEST binding posts, as applicable, and observe the NULL INDICATOR meter.

    (1) Upper-Limit Test. For a go result, the meter must indicate in the LO sector of the meter scale. Midscale is the absolute upper limit. If the meter indicates in the HI sector of the scale, the specimen is higher in capacitance than the upper limit, and the test result is no-go.

    (2) Lower-Limit Test. For a go result, the meter must indicate in the HI sector of the meter scale. Midscale is the absolute lower limit. If the meter indicates in the LO sector of the scale, the specimen is lower in capacitance than the lower limit, and the test result is no-go.

3.8.2 SINGLE-LIMIT INDUCTANCE TEST. The Model 75D is used in the following procedure to perform go/no-go tests of inductive specimens that are to be sorted. In this test, Model 75D compares the inductance (i.e., equivalent capacitance) of each specimen with either an upper-limit value or a lower-limit value that has been programmed into the instrument, and a go or no-go readout indicates the test result. Although the instrument can be programmed for only one limit, dual-limit tests may be performed by repeating the procedure for the other limit.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

b. If coaxial test leads or a test jig is to be used, connect the item to the REMOTE STD coaxial connectors.

c. Determine the tolerance limit required and set the MULTIPLY C, DIVIDE G/MULTIPLY R, and C/L switches to the positions indicated in the chart below. (Do not adjust the CONDUCTANCE control.) If the tolerance is in percentage, convert the percentage tolerance to inductance values and algebraically add the required tolerance to the nominal value of the specimen. (For example, a $\pm$ 5% tolerance for a nominal 0.4 mH inductor converts to $\pm$ 0.02 mH and becomes 0.42 mH for the upper limit and 0.38 mH for the lower limit.)

TOLERANCE LIMIT (pF)	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
25 μH to 250 μH	1	1	C	+1000
250 μH to 2.5 μH	0.1	1	L	-100*
2.5 mH to 25 mH	0.01	10	L	-100*

* Tenth (red) subdivision on G-scale to the left of zero.

d. Zero-balance the bridge as described in paragraph 3.5.

e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.

f. Refer to the chart in Step c, above, and adjust the CONDUCTANCE control to the required position.

g. Adjust the PHASE control until the meter needle is exactly at midscale.

h. Return the CONDUCTANCE control to zero on the G-scale.

i. If the C/L switch is at L, proceed to Step l. If the C/L switch is at C, set it to the L position.

j. Set the meter switch to ZERO LEFT and zero-balance the bridge as described in paragraph 3.5.

k. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.

l. Convert the inductance limit value to an equivalent capacitance value. Use the following equation:

$$C = 25.33/C$$

where C = capacitance in pF

L = inductance in mH

(If the upper limit were required in the Step c example, 0.42 mH would convert to 60.31 pF. If the lower limit were required, 0.38 mH would convert to 66.66 pF.)

m. Advance the CAPACITANCE control to the capacitance value derived in Step l, above.

(For the 60.31 pF upper limit in the Step 1 example, the MULTIPLY C switch would be in the 0.1 position and the CAPACITANCE control would be advanced to 600 on the upper dial and to 3.1 on the lower dial. If the lower limit were required, the CAPACITANCE control would be advanced to 600 on the upper dial and 66.6 on the lower dial.)

n. The Model 75D now is programmed to perform single-limit, go/no-go tests. Sequentially connect the inductive specimens to the test jig, coaxial leads, or the REMOTE STD coaxial connectors, as applicable, and observe the NULL INDICATOR meter.

(1) Upper-Limit Test. For a go result, the meter must indicate in the HI sector of the meter scale. Midscale is the absolute upper limit. If the meter indicates in the LO sector of the scale, the specimen is higher in inductance than the upper limit, and the test result is no-go.

(2) Lower-Limit Test. For a go result, the meter must indicate in the LO sector of the meter scale. Midscale is the absolute lower limit. If the meter indicates in the HI sector of the scale, the specimen is lower in inductance than the lower limit, and the test result is no-go.

NOTE:

Because inductance is a reciprocal function of capacitance, the HI and LO indications for the Step n tests, above, are the reverse of those obtained during the corresponding tests of capacitive specimens in Step m of paragraph 3.1.2.

PART V. DIFFERENTIAL MEASUREMENTS

3.9 GENERAL. Follow the applicable procedure to measure the differential of capacitive or inductive specimens. Procedures are given for both the amplitude mode and the phase mode. Differential measurements may be performed in either mode; however, use of the phase mode provides a meter sensitivity increase of 10, or 20 dB. When reading values on the CAPACITANCE dial, apply the MULTIPLY C factor to the reading.

3.9.1 MEASURING DIFFERENTIAL CAPACITANCE IN THE AMPLITUDE MODE

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow 15 minutes for warm-up after switching on.

b. If the test specimen is to be connected directly to the TEST binding posts, remove the terminal shield. If coaxial test leads or a test jig is to be used, connect the leads or jig to the REMOTE TEST coaxial connectors.

c. Refer to the chart below and set the MULTIPLY C switch to a position corresponding with the anticipated differential.

ANTICIPATED DIFFERENTIAL VALUE (pF)	MULTIPLY C SWITCH SETTING
100 to 1000	1
10 to 100	0.1
1 to 10	0.01
0.1 to 1	0.001
0 to 0.1	0.0001

d. Zero-balance the bridge as described in paragraph 3.5.

e. Connect the test specimen either to the TEST binding posts or to the REMOTE TEST coaxial connectors, test jig, or test leads, as required.

f. At the REMOTE STD terminals connect a reference capacitor whose value and accuracy are known.

g. Advance the CAPACITANCE control for a null indication on the meter. If the meter does not null, the value of the reference capacitor is greater than the value of the test specimen; interchange the two items and readjust the CAPACITANCE control.

h. Read the differential value on the CAPACITANCE dial. If the two capacitors were interchanged in Step g, above, the dial reading indicates the negative differential value of the test specimen with respect to the reference capacitor.

3.9.2 MEASURING CAPACITOR TEMPERATURE COEFFICIENT IN AMPLITUDE MODE

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow 15 minutes for warm-up after switching on.

b. Check that the oven is switched off and that ambient temperature requirements are in accordance with the user's specifications.
c. Connect a test specimen of known value to the oven-chamber terminals and connect the oven coaxial cables to the REMOTE TEST coaxial connectors.
d. At the REMOTE STD terminals, connect a stable, variable capacitor whose range covers the value of the test specimen plus the capacitance introduced into the bridge circuit in Steps e and f below.
e. Establish a midscale reference by advancing the CAPACITANCE control to 500.
f. Set the MULTIPLY C switch to a position consistent with the anticipated differential.
g. Adjust the variable capacitor for optimum meter null and then zero balance the bridge as described in paragraph 3.5.
h. Energize the oven and time the test specimen for a thermal cycle in accordance with the user's specification.
i. At each required temperature level, adjust the CAPACITANCE control for a null indication on the meter and read the differential value on the dial. An upscale reading indicates the positive differential value of the specimen with respect to reference capacitance, and a downscale reading indicates the negative differential value.

3.9.3 MEASURING DIFFERENTIAL INDUCTANCE IN AMPLITUDE MODE.

In this method, inductance is measured in terms of equivalent capacitance, which is translated to inductance by simple computation.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow 15 minutes for warm-up after energizing the instrument.

b. If coaxial test leads or a test jig is to be used, connect either to the REMOTE STD coaxial connectors.
c. Estimate the approximate differential value and set the MULTIPLY C switch as indicated in the following chart:

ANTICIPATED DIFFERENTIAL VALUE	MULTIPLY C SWITCH SETTING
25 μH to 250 μH	1
250 μH to 2.5 mH	0.1
2.5 mH to 25 mH	0.01

d. Set the C/L switch to the L position.
e. Zero-balance the bridge as described in paragraph 3.5.
f. Connect the test inductor to the REMOTE STD coaxial connectors (or to the test jig or test leads, if used).
g. At the REMOTE STD terminals, connect a reference inductor whose value and accuracy are known.
h. Advance the CAPACITANCE control for a null indication on the meter. If the meter does not null, the value of the reference inductor is greater than the value of the test inductor; interchange the two inductors and readjust the CAPACITANCE control.
i. Read the value on the CAPACITANCE dial and use the following equation to convert the capacitance reading to an inductance differential value:

$$L = 25.33/C$$

where L = inductance in mH

C = CAPACITANCE dial reading in pF

3.9.4 MEASURING DIFFERENTIAL CAPACITANCE IN PHASE MODE.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow one hour warm-up to ensure thermal stabilization of the phase detector circuit.

b. If the test specimen is to be connected directly to the TEST binding posts, remove the terminal shield. If coaxial test leads or a test jig is to be used, connect either to the REMOTE TEST coaxial connectors.
c. Refer to the following chart and set the MULTIPLY C, DIVIDE G/MULTIPLY R, C/L switches to positions corresponding with the anticipated differential. (Do not adjust the CONDUCTANCE control.)

ANTICIPATED DIFFERENTIAL VALUE (pF)	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
100 to 1000	1	1	L	+1000
10 to 100	0.1	1	C	-100*
1 to 10	0.01	10	C	-100*
0.1 to 1	0.001	100	C	-100*
0 to 0.1	0.0001	1000	C	-100*

*Tenth (red) subdivision on G-scale to the left of zero.

d. Zero-balance the bridge as described in paragraph 3.5.
e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
f. Refer to the chart in Step c, above, and set the CONDUCTANCE control to the required position.
g. Adjust the PHASE control until the meter needle is at midscale.
h. Return the CONDUCTANCE control to zero on the G-scale.
i. If the C/L switch is at C, proceed to Step l, below. If the C/L switch is at L, set it to the C position.
j. Set the meter switch to ZERO LEFT and zero balance the bridge as described in paragraph 3.5.
k. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
l. Connect the test specimen either to the TEST binding posts or to the REMOTE TEST coaxial connectors, test jig, or test leads, as required.
m. At the REMOTE STD terminals, connect a reference capacitor whose value and accuracy are known.
n. Advance the CAPACITANCE control for an exact midscale indication on the meter. If the meter does not null at midscale, the value of the reference capacitor is greater than the value of the test specimen; interchange the two capacitors and readjust the CAPACITANCE control.
o. Read the differential value on the CAPACITANCE dial.
If the two capacitors were interchanged in Step n, above, the dial reading indicates the negative differential value of the test specimen with respect to the reference capacitor.

3.9.5 MEASURING CAPACITOR TEMPERATURE COEFFICIENT IN PHASE MODE.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow one hour warm-up to ensure thermal stabilization of the phase detector circuit.

b. Check that the oven is turned off and that ambient temperature requirements are in accordance with the user's specification.
c. Connect the oven coaxial cables to the REMOTE TEST coaxial connectors.
d. Refer to the chart below and set the MULTIPLY C, DIVIDE G/MULTIPLY R, and C/L switches to positions corresponding with the anticipated differential. (Do not adjust the CONDUCTANCE control.)

ANTICIPATED DIFFERENTIAL VALUE (pF)	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
100 to 500	1	1	L	+1000
10 to 100	0.1	1	C	-100*
1 to 10	0.01	10	C	-100*
0.1 to 1	0.001	100	C	-100*
0 to 0.1	0.0001	1000	C	-100*

* Tenth (red) subdivision on G-scale to the left of zero.

e. Zero-balance the bridge as described in paragraph 3.5.
f. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
g. Refer to the chart in Step d, above, and set the CONDUCTANCE control to the required position.
h. Adjust the PHASE control until the meter needle is at midscale.
i. Return the CONDUCTANCE control to zero on the G-scale. If the C/L switch is at C, proceed to Step m, below.
j. If the C/L switch is at L, set it to the C position.
k. Set the meter switch to ZERO LEFT and zero balance the bridge as described in paragraph 3.5.
l. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
m. Connect a test specimen of known value to the oven-chamber terminals.
n. At the REMOTE STD terminals, connect a stable, variable capacitor whose range covers the value of the test specimen plus the capacitance introduced into the bridge circuit in Step o, below.
o. Establish a midscale dial reference by advancing the CAPACITANCE control to 500.

p. Adjust the variable capacitor for a midscale meter indication. If necessary, use the C ZERO FINE control to center the meter needle.
q. Energize the oven and time the test specimen for a thermal cycle in accordance with the user's specification.
r. At each required temperature level, adjust the CAPACITANCE control for an exact midscale indication on the meter and read the differential value on the dial. An upscale reading indicates the positive differential value of the specimen with respect to the reference capacitance, and a downscale reading indicates the negative differential value.

3.9.6 MEASURING DIFFERENTIAL INDUCTANCE IN PHASE MODE.

This method measures the differential inductance in terms of equivalent capacitance, which is translated by simple computation.

a. Check that the initial settings on the front panel of the Model 75D are in accordance with Table 4.

NOTE:

Allow one hour warm-up to ensure thermal stabilization of the phase detector circuit.

b. If coaxial test leads or a test jig is to be used, connect either to the REMOTE STD coaxial connectors.
c. Refer to the chart below and set the MULTIPLY C, DIVIDE G/MULTIPLY R, and C/L switches to positions corresponding with the anticipated differential. (Do not adjust the CONDUCTANCE control.)

ANTICIPATED DIFFERENTIAL VALUE	MULTIPLY C SWITCH	DIVIDE G/ MULTIPLY R SWITCH	C/L SWITCH	CONDUCTANCE CONTROL G-SCALE
25 μH to 250 μH	1	1	C	+1000
250 μH to 2.5 mH	0.1	1	L	-100*
2.5 mH to 25 mH	0.01	10	L	-100*

* Tenth (red) subdivision on G-scale to the left of zero.

d. Zero-balance the bridge as described in paragraph 3.5.
e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.
f. Refer to the chart in Step c, above, and set the CONDUCTANCE control to the required position.
g. Adjust the PHASE control until the meter needle is at midscale.

h. Return the CONDUCTANCE control to zero on the G-scale.

i. If the C/L switch is at C, proceed to Step l, below. If the C/L switch is at L, set it to the C position.

j. Set the meter switch to ZERO LEFT and zero balance the bridge as described in paragraph 3.5.

k. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control for a midscale meter indication.

l. Connect the test inductor to the REMOTE STD coaxial connectors (or to the test jig or test leads, if used).

m. At the REMOTE TEST terminals, connect a reference inductor whose value and accuracy are known.

n. Advance the CAPACITANCE control for an exact midscale indication on the meter. If the meter does not null at midscale, the value of the reference inductor is greater than the value of the test inductor; interchange the two inductors and readjust the CAPACITANCE control.

o. Read the value on the CAPACITANCE dial and use the following equation to convert the capacitance reading to an inductance differential value:

$$L = 25.33/C$$

where L = inductance in mH

C = CAPACITANCE dial reading in pF

Nomograph for D or Q of Capacitors

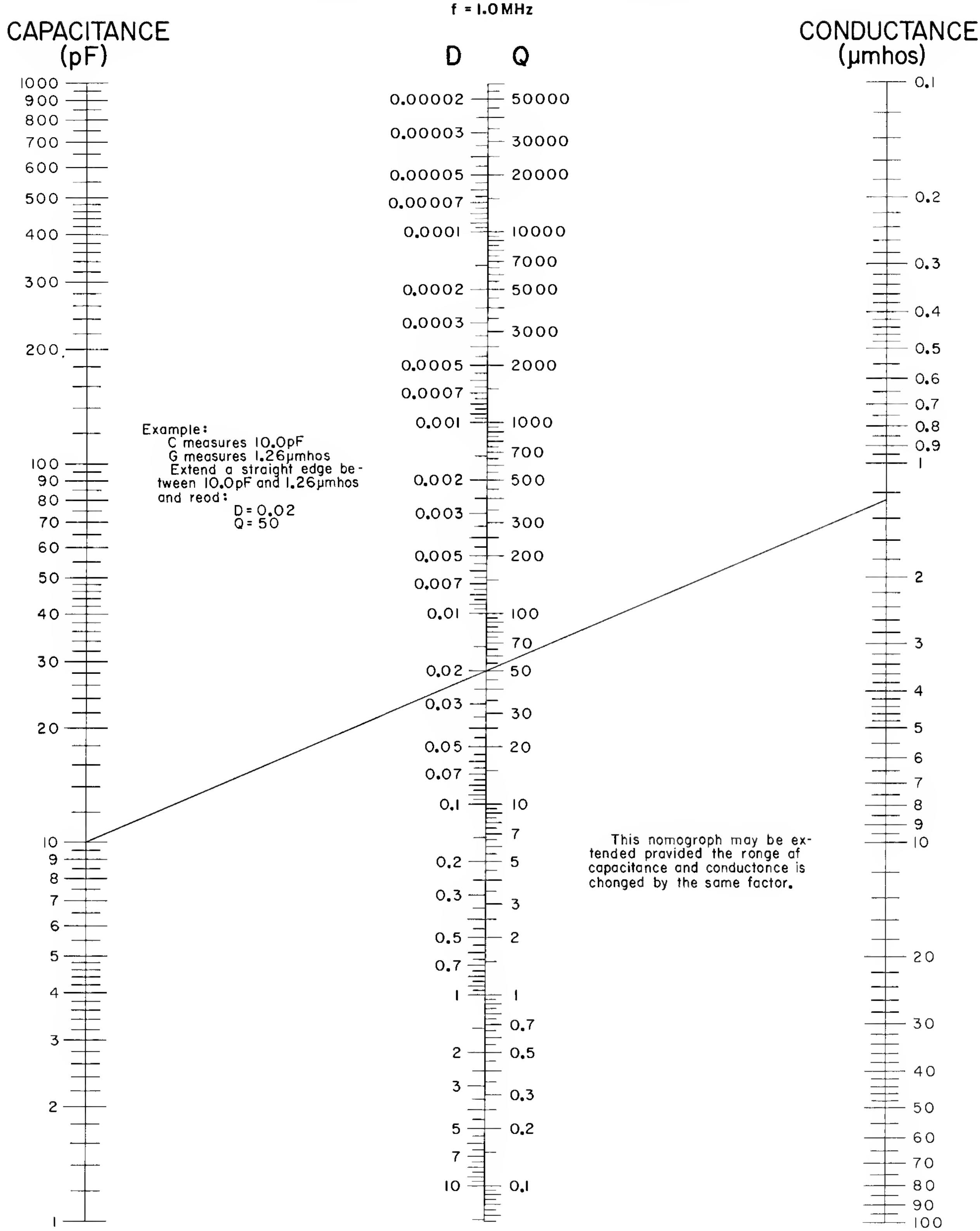


Figure 9. Nomograph

CHAPTER 4

MAINTENANCE

4.1 GENERAL. This chapter contains information necessary to perform preventive and corrective maintenance on the Model 75D. When corrective maintenance is indicated, the work should be done by technically-qualified people, and should follow normal practices and techniques. Before performing corrective maintenance, review the theory of operation in Chapter 5. An understanding of the Model 75D operating principles will make corrective maintenance much easier.

4.2 PREVENTIVE MAINTENANCE. With proper care, the Model 75D normally will require only periodic performance tests (Part 1) and occasional alignment or calibration (Part III). Abusive or careless handling of the Model 75D can cause malfunctions or failures. A dropped or severely jarred equipment is almost certain to require alignment or calibration, and more serious malfunctions or part failures may result. The only preventive maintenance recommended for the Model 75D is the exercise of reasonable and professional care plus an occasional wipedown of the external surfaces when required.

CAUTION:

Do not attempt to lubricate any internal gears or moving parts because dust will accumulate and clogging may result.

4.3 CORRECTIVE MAINTENANCE. The corrective maintenance instructions and data required to service the Model 75D are provided in the following sections of this chapter. Part I contains test procedures for checking the performance of the Model 75D. When servicing is required, refer to Part II for troubleshooting information. If alignment or calibration is required, the troubleshooting chart will refer to the applicable procedure in Part III. While servicing the Model 75D, follow the applicable disassembly and reassembly procedures in Part IV to gain access to an internal assembly and to reassemble the equipment after servicing is completed.

PART 1. EQUIPMENT PERFORMANCE TESTS

4.4 USING THE EQUIPMENT PERFORMANCE CHECKLIST. Use the equipment performance checklist in Table 5 to test the functional operation of the Model 75D. When using the checklist, perform every step of the procedure in the numerical sequence indicated. A properly functioning equipment should meet all performance standards. If the performance of the Model 75D is substandard, proceed to Part II in this chapter for troubleshooting instructions. If desired, the Model 75D may be returned to the factory for repairs; however, first call on either the manufacturer or your nearest sales engineering representative for consultation. Typical applications of the equipment performance checklist are as follows:

a. As an incoming-inspection procedure.
b. Whenever substandard performance is suspected.
c. To final test the Model 75D when corrective maintenance is completed.

d. Semi-annually, for periodic equipment checkout.

4.5 TEST EQUIPMENT AND ACCESSORIES REQUIRED.

a. One Multimeter, Simpson Model 260; or VTVM, RCA Voltohmyst Model WV-77E, or equivalent.
b. One RF Voltmeter, Boonton Electronics Model 92A, or equivalent.
c. One 10kΩ, 1/2 watt resistor.
d. One 2-conductor, 1/4" telephone plug equipped with two leads (tip and sleeve) approximately one-foot long.

Table 5. Equipment Performance Checklist

STEP	ITEM	ACTION OR CONDITON	PERFORMANCE STANDARD
1.	Initial Procedures	a. Power cable is connected to a compatible ac source and power switch is in the off position.	a. Pilot lamp is extinguished and NULL INDICATOR pointer rests at midscale increment.
		b. Operate power switch to ON and allow one hour for warm-up.	b. Pilot lamp glows.
		c. Adjust front panel controls in accordance with Table 4, except set the MULTIPLY C switch to .1.	c. None.
2.	Bridge and detector circuits check.	a. Zero-balance the bridge as described in paragraph 3.5.	a. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		b. Set meter switch to ZERO CENTER position.	b. NULL INDICATOR pointer deflects toward midscale.
		c. If necessary, adjust C ZERO FINE control until NULL INDICATOR pointer is centered.	c. NULL INDICATOR pointer is at midscale increment.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
2. (Cont'd)		d. Set meter switch to ZERO LEFT position.	d. NULL INDICATOR dips to within one subdivision of zero on LO sector of dial scale.
		e. Set meter switch back to ZERO CENTER position.	e. NULL INDICATOR pointer returns to mid-scale increment.
		f. Operate CAPACITANCE control to 10 pF.	f. NULL INDICATOR pointer deflects down-scale toward zero on LO sector of dial scale.
		g. Operate CAPACITANCE control to minus 10 position.	g. NULL INDICATOR pointer deflects upscale on HI sector of dial scale.
		h. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	h. None.
3.	Phase and amplitude detector synchron-ization check.	a. Check that all front panel controls are in accordance with Table 4.	a. None.
		b. Zero-balance the bridge as described in para-graph 3.5.	b. NULL INDICATOR pointer dips to within three subdivisions of zero on LO sector of dial scale.
		c. Set meter switch to ZERO CENTER.	c. NULL INDICATOR pointer deflects toward midscale.
		d. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered.	d. NULL INDICATOR pointer is at midscale increment.
		e. Read CAPACITANCE dial.	e. CAPACITANCE dial < 1 pF.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
3. (Cont'd)		f. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	f. None.
		g. Set MULTIPLY C switch to 0.1.	g. None
		h. Zero-balance the bridge as described in paragraph 3.5.	h. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		i. Set meter switch to ZERO CENTER.	i. NULL INDICATOR pointer deflects toward midscale.
		j. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered.	j. NULL INDICATOR pointer is at midscale increment.
		k. Read CAPACITANCE dial.	k. CAPACITANCE dial reads < 1 pF.
		l. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	l. None.
		m. Set MULTIPLY C switch to 0.01.	m. None.
		n. Zero-balance the bridge as described in paragraph 3.5.	n. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		o. Set meter switch to ZERO CENTER.	o. NULL INDICATOR pointer deflects toward midscale.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
3. (Cont'd)		p. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered.	p. NULL INDICATOR pointer is at midscale increment.
		q. Read CAPACITANCE dial.	q. CAPACITANCE dial reads < 1 pF.
		r. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	r. None.
		s. Set MULTIPLY C switch to 0.001.	s. None.
		t. Zero balance the bridge as described in paragraph 3.5.	t. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		u. Set meter switch to ZERO CENTER	u. NULL INDICATOR pointer deflects toward midscale.
		v. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered.	v. NULL INDICATOR pointer is at midscale increment.
		w. Read CAPACITANCE dial.	w. CAPACITANCE dial reads < 1 pF.
		x. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	x. None.
		y. Set MULTIPLY C switch to 0.0001.	y. None.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
3. (Cont'd)		z. Zero-balance the bridge as described in paragraph 3.5.	z. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		aa. Set meter switch to ZERO CENTER.	aa. NULL INDICATOR pointer deflects toward midscale.
		ab. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered.	ab. NULL INDICATOR pointer is at midscale increment.
		ac. Read CAPACITANCE dial.	ac. CAPACITANCE dial reads < 1 pF.
		ad. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	ad. None.
4.	A. Phase Discrimination Check, 0.0001 Multiply C Range	a. Set MULTIPLY C switch to 0.0001.	a. None.
		b. Set C/L switch to L.	b. None.
		c. Set meter switch to ZERO LEFT.	c. None.
		d. Zero-balance the bridge as described in paragraph 3.5.	d. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		e. Set meter switch to ZERO CENTER.	e. NULL INDICATOR pointer deflects toward midscale.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
4. (Cont'd)		f. If necessary, adjust C ZERO FINE control until NULL INDICATOR pointer is centered.	f. NULL INDICATOR pointer is at midscale increment.
		g. Set CONDUCTANCE control to 100 μmhos on the G-scale.	g. NULL INDICATOR pointer deflects away from midscale.
		h. Adjust PHASE control until NULL INDICATOR pointer is centered.	h. NULL INDICATOR pointer is at midscale increment.
		i. Set CONDUCTANCE control to 650 μmhos on the G-scale.	i. NULL INDICATOR pointer deflects away from midscale.
		j. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered on midscale increment and read the CAPACITANCE dial (times the 0.0001 MULTIPLY C setting).	j. Capacitance reads zero, ± 0.01 pF.
		k. Set CAPACITANCE and CONDUCTANCE controls back to zero.	k. None.
	B. Phase Discrimination Check, 0.001 Multiply C Range	a. Set MULTIPLY C switch to 0.001.	a. None.
		b. Set DIVIDE G/MULTIPLY R switch to 100.	b. None.
		c. Set meter switch to ZERO LEFT.	c. None.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
4. (Cont'd)		d. Zero-balance the bridge as described in paragraph 3.5.	d. NULL INDICATOR pointer dips within one subdivision of zero on LO sector of dial scale.
		e. Set meter switch to ZERO CENTER.	e. NULL INDICATOR pointer deflects toward midscale.
		f. If necessary, adjust C ZERO FINE control to center the NULL INDICATOR pointer.	f. NULL INDICATOR pointer is at midscale increment.
		g. Set CONDUCTANCE control to 100 µmhos on the G-scale.	g. NULL INDICATOR pointer deflects away from midscale.
		h. Adjust PHASE control until NULL INDICATOR pointer is centered.	h. NULL INDICATOR pointer is at midscale increment.
		i. Set CONDUCTANCE control to 650 µmhos on the G-scale.	i. NULL INDICATOR pointer deflects away from midscale.
		j. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered on midscale increment and read the CAPACITANCE dial (times the 0.001 MULTIPLY C setting).	j. Capacitance is within ± 0.03 pF.
		k. Set CAPACITANCE and CONDUCTANCE controls back to zero.	k. None.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
4 C. (Cont'd)	Phase Discrimination Check, 0.01 Multiply C Range	a. Set MULTIPLY C switch to 0.01.	a. None.
		b. Set DIVIDE G/MULTIPLY R switch to 10.	b. None.
		c. Set meter switch to ZERO LEFT.	c. None.
		d. Zero balance the bridge as described in paragraph 3.5.	d. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		e. Set meter switch to ZERO CENTER.	e. NULL INDICATOR pointer deflects toward midscale.
		f. If necessary, adjust C ZERO FINE control to center the NULL INDICATOR pointer.	f. NULL INDICATOR pointer is at midscale increment.
		g. Set CONDUCTANCE control to 100 µmhos on the G-scale.	g. NULL INDICATOR pointer deflects away from midscale.
		h. Adjust PHASE control until NULL INDICATOR pointer is centered.	h. NULL INDICATOR pointer is at midscale increment.
		i. Set CONDUCTANCE control to 650 µmhos on the G-scale.	i. NULL INDICATOR pointer deflects away from midscale.
		j. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered on midscale increment and read the CAPACITANCE dial (times 0.01 MULTIPLY C setting).	j. Capacitance is within $\pm$ 0.3 pF.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
4. (Cont'd)		k. Set CAPACITANCE and CONDUCTANCE controls back to zero.	k. None.
	D. Phase Discrimination Check, 0.1 Multiply C Range	a. Set MULTIPLY C switch to 0.1.	a. None.
		b. Set DIVIDE G/MULTIPLY R switch to 1.	b. None.
		c. Set meter switch to ZERO LEFT.	c. None.
		d. Zero balance the bridge as described in paragraph 3.5.	d. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		e. Set meter switch to ZERO CENTER.	e. NULL INDICATOR pointer deflects toward midscale.
		f. If necessary, adjust C ZERO FINE control until NULL INDICATOR pointer is centered.	f. NULL INDICATOR pointer is at midscale increment.
		g. Set CONDUCTANCE control to 100 µmhos on the G-scale.	g. NULL INDICATOR pointer deflects away from midscale.
		h. Adjust PHASE control until NULL INDICATOR pointer is centered.	h. NULL INDICATOR pointer is at midscale increment.
		i. Set CONDUCTANCE control to 650 µmhos on the G-scale.	i. NULL INDICATOR pointer deflects from midscale.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
4. D. (Cont'd)			
		j. Adjust CAPACITANCE control until NULL INDICATOR pointer is centered on midscale increment and read the CAPACITANCE dial (times the 0.1 MULTIPLY C setting).	j. Capacitance is within ± 3 pF.
		k. Set CAPACITANCE and CONDUCTANCE controls back to zero.	k. None.
5.	Sensitivity check.	a. Check that all front panel controls are in accordance with Table 4.	a. None.
		b. Set MULTIPLY C switch to 0.0001.	b. None.
		c. Zero-balance the bridge as described in paragraph 3.5.	c. NULL INDICATOR pointer dips to within one subdivision of zero on LO sector of dial scale.
		d. Set CONDUCTANCE control to 20 μmhos on the G-scale.	d. NULL INDICATOR pointer deflects upscale at least one major increment on LO sector of dial scale.
		e. Set meter switch to ZERO CENTER position.	e. NULL INDICATOR pointer deflects toward midscale.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
5.	Sensitivity check. (Cont'd)	f. Adjust C ZERO FINE control until NULL INDICATOR pointer is at either edge of mid-scale increment.	f. None.
		g. Adjust CAPACITANCE control until NULL INDICATOR pointer is at opposite edge of mid-scale increment and read the CAPACITANCE dial (times the 0.0001 MULTIPLY C setting).	g. Capacitance is < 0.0004 pF.
		h. Set CAPACITANCE control to zero and meter switch to ZERO LEFT.	h. None.
6.	1 MHz oscillator check.	a. Check that terminal shield is removed from TEST binding posts.	a. None.
		b. Adjust rf voltmeter to measure approximately 300 millivolts.	b. None.
		c. Rotate TEST LEVEL control fully counter-clockwise.	c. None.
		d. Connect rf voltmeter probe tip to TEST LO binding post. Connect probe clip to TEST ground binding post.	d. Rf voltmeter indicates less than 1 mV.
		e. Rotate TEST LEVEL control fully clockwise.	e. Rf voltmeter indicates at least 250 mV.
		f. Remove test probe from Model 75D.	f. None.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
7.	Detector gain check		
		a. Check that all front panel controls are in accordance with Table 4.	a. None
		b. Zero-balance the bridge as described in paragraph 3.5.	b. NULL INDICATOR pointer dips to within three subdivisions of zero on LO sector of dial scale.
		c. Adjust CONDUCTANCE control until NULL INDICATOR pointer deflects upscale to the second major increment. Record the µmho reading on CONDUCTANCE G-scale.	c. NULL INDICATOR pointer rests at second major increment on meter scale.
		d. Rotate GAIN control fully counterclockwise.	d. NULL INDICATOR pointer deflects downscale toward zero in LO sector of dial scale.
		e. Set CONDUCTANCE control to zero on G-scale. If necessary, zero balance the bridge as described in paragraph 3.5.	e. NULL INDICATOR pointer dips to within three subdivisions of zero on LO sector of dial scale.
		f. Adjust CONDUCTANCE control until NULL INDICATOR pointer deflects upscale to the second major increment. Record the µmho reading on CONDUCTANCE G-scale and compare with the reading obtained in c, above.	f. CONDUCTANCE dial is approximately 5 times the reading recorded in c, above.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
7.	Detector gain check (Cont'd)	g. Set CONDUCTANCE control to zero on G-scale and rotate GAIN control fully clockwise.	g. None.
8.	Internal bias voltage check.	a. Check that all front panel controls are in accordance with Table 4.	a. None.
		b. Remove terminal shield from TEST binding posts.	b. None.
		c. Set the DC BIAS switch to +INT.	c. None.
		d. Adjust multimeter to measure at least +150 volts.	d. None.
		e. Connect multimeter positive prod to TEST HI binding post and negative prod to TEST LO binding post.	e. Multimeter indicates zero on the dc scale.
		f. Rotate DC BIAS INTERNAL ADJUST control fully clockwise.	f. Multimeter pointer deflects smoothly from zero to +140 ± 10 volts on dc scale.
		g. Rotate DC BIAS INTERNAL ADJUST control fully counterclockwise.	g. Multimeter pointer deflects smoothly back to zero on dc scale.
		h. Adjust multimeter to measure at least -10 volts.	h. None.
		i. Set DC BIAS switch to -INT.	i. Multimeter indicates zero on dc scale.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
8. (Cont'd)	Internal bias voltage check.	j. Rotate DC BIAS INTERNAL ADJUST control fully clockwise.	j. Multimeter pointer deflects smoothly from zero to -6 ± 0.5 volts on dc scale.
		k. Rotate DC BIAS INTERNAL ADJUST control fully counterclockwise.	k. Multimeter pointer deflects smoothly back to zero on dc scale.
		l. Remove multimeter prods from TEST binding posts and connect prods to DC BIAS INTERNAL MONITOR E and ground binding posts (positive prod to E post and negative prod to ground post).	l. Multimeter pointer indicates zero on dc scale.
		m. Rotate DC BIAS INTERNAL ADJUST control fully clockwise.	m. Multimeter pointer deflects smoothly from zero to -6 ± 0.5 volts on dc scale.
		n. Rotate DC BIAS INTERNAL ADJUST control fully counterclockwise.	n. Multimeter pointer deflects smoothly back to zero on dc scale.
		o. Set DC BIAS switch to +INT.	o. None.
		p. Adjust multimeter to measure at least +150 volts.	p. Multimeter indicates zero on dc scale.
		q. Rotate DC BIAS INTERNAL ADJUST control fully clockwise.	q. Multimeter pointer deflects smoothly from zero to $+140 \pm 10$ volts on dc scale.
		r. Rotate DC BIAS INTERNAL ADJUST control fully counterclockwise.	r. Multimeter pointer smoothly deflects back to zero on dc scale.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
8. (Cont'd)	Internal bias voltage check.	s. Set DC BIAS switch to OFF and remove the test prods from the Model 75D.	s. None.
9.	Internal bias current check.	a. Check that DC BIAS INTERNAL ADJUST control is fully counter-clockwise.	a. None.
		b. Set DC BIAS switch to +INT.	b. None.
		c. Connect a 10 kohm 1/2 watt resistor across TEST HI and LO binding posts.	c. None.
		d. Adjust multimeter to measure at least 5 mA dc.	d. None
		e. Connect multimeter prods to telephone plug so that positive prod is at tip terminal (center conductor on plug) and negative prod is at sleeve terminal (outer conductor on telephone plug).	e. None.
		f. Insert telephone plug into DC BIAS INTERNAL MONITOR 1 jack.	f. Multimeter indicates zero on dc scale.
		g. Rotate DC BIAS INTERNAL ADJUST control fully clockwise.	g. Multimeter pointer deflects smoothly from zero to 4.4 mA ± 10%.
		h. Rotate DC BIAS INTERNAL ADJUST control fully counter-clockwise.	h. Multimeter pointer smoothly deflects back to zero on dc scale.

Table 5. . Equipment Performance Checklist (Cont'd)

STEPS	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
9. (Cont'd)	Internal bias current check.	i. Remove 10 kohm resistor from TEST HI and LO binding posts.	i. None.
		j. Remove multimeter prods from telephone plug.	j. None.
		k. Remove telephone plug from Model 75D.	k. None.
		l. Set DC BIAS switch to EXT.	l. None.
		m. Adjust multimeter to measure resistance on lowest R setting.	m. None.
		n. Connect one multimeter prod to DC BIAS EXTERNAL HI binding post and connect the other prod to TEST HI binding post.	n. Multimeter indicates 20 ohms $\pm$ 20%.
		o. Remove jumper from DC BIAS EXTERNAL LO and ground binding posts.	o. None.
		p. Remove test prod from DC BIAS EXTERNAL HI binding post and connect it to DC BIAS EXTERNAL LO binding post. Remove test prod from TEST HI binding post and connect it to TEST LO binding post.	p. Multimeter indicates 12 ohms $\pm$ 20%.

Table 5. Equipment Performance Checklist (Cont'd)

STEP	ITEM	ACTION OR CONDITION	PERFORMANCE STANDARD
9. (Cont'd)	Internal bias current check.	q. Remove test prods from Model 75D and set DC BIAS switch to OFF.	q. None.
		r. Install jumper between DC BIAS EXTERNAL LO and ground binding posts.	r. None.

PART II. TROUBLESHOOTING

4.6 GENERAL. The troubleshooting chart in Table 6 lists faults in descending order of probability. This order of probability should be followed unless inspection reveals an obvious defect, such as a charred part, a broken lead, or arcing discoloration. Use the troubleshooting chart as a guide to locate a fault in one of the main assemblies in the Model 75D and then to isolate a fault to a stage or circuit. Most faults then can be isolated by performing voltage and resistance (V & R) measurements in accordance with Figure II. When troubleshooting a stage or circuit, also check associated wiring and any interconnecting cabling. Use the schematic diagram to trace circuits and to obtain values of component parts. If a fault is located in the oscillator-detector assembly, use Figure 14 as a supplementary diagnostic aid. During troubleshooting refer to Figures 12 through 13 and the schematic as applicable, for locations of parts and internal controls. When troubleshooting and repairs are completed, perform the entire procedure in the equipment performance checklist (Table 5) as a final test.

NOTE:

If a fault or malfunction appears to be in the bridge assembly, call on the Boonton Electronics Corporation or your nearest sales engineering representative. The Model 75D warranty will be null and void if the seals on the bridge assembly are broken or removed without authorization.

PART III. ALIGNMENT AND CALIBRATION

4.7 GENERAL. When alignment or calibration is required, perform only the alignment or calibration procedures called for in the troubleshooting chart (Table 6). Each alignment or calibration procedure lists the required test equipment and contains applicable disassembly and reassembly references. When more than one procedure is to be performed, reassemble the Model 75D after the last procedure is completed. Figures 12 and 13 indicate the internal controls used for alignment or calibration.

4.8 NULL INDICATOR ALIGNMENT (R307).

(1) Test equipment: None.
(2) Procedure:

a. Remove the Model 75D cabinet (par. 4.12).
b. Adjust the Model 75D front panel controls in accordance with Table 4.
c. Turn the GAIN control fully counterclockwise (ccw).
d. Remove tube V203.
e. Adjust R307 until the NULL INDICATOR pointer is directly over the extreme left increment (zero) in the LO sector of the meter scale.

f. Replace tube V203.
g. If no other alignment is required, install the Model 75D in its cabinet (par. 4.12).

4.9 OSCILLATOR-DETECTOR ALIGNMENT.

Note: See Test Points and Waveforms drawing at back of book.

a. The internal controls used to align the oscillator-detector are shown in Figure 11, Pg.83. When the Model 75D is removed from its cabinet, the controls are accessible. After the required alignment procedures are completed, reassemble the Model 75D.

b. Oscillator Alignment (L205).
   (1) Test equipment: RF Voltmeter Type 92 (Boonton Electronics Corporation) or equivalent.
   (2) Procedure:

      a Remove the Model 75D cabinet (par. 4.12).
      b. Adjust the Model 75D front panel controls in accordance with Table 4.
      c. Adjust the rf voltmeter to measure approximately 0.3 volts.
      d. Connect the voltmeter probe between the LO TEST terminal ground and binding posts on the Model 75D front panel.
      e. Loosen the locking nut on internal control L205 by turning counterclockwise (ccw).
      f. Adjust L205 for a maximum voltage indication on the rf voltmeter.
      g. Tighten the locking nut on L205 by turning clockwise (cw).

c. Detector input Alignment (L101).

   (1) Test equipment: RF Voltmeter Type 92 (Boonton Electronics Corporation) or equivalent.
   (2) Procedure:

      a. Remove the cabinet.
      b. Adjust the Model 75D front panel controls in accordance with Table 4.
      c. Set the MULTIPLY C switch to .1.
      d. Set the DIVIDE G/MULTIPLY R switch to 10.
      e. Zero-balance the bridge as described in paragraph 3.5.
      f. Advance the CAPACITANCE control to 1000 pF on the dial.
      g. Adjust the rf voltmeter to measure approximately 0.01 volt.
      h. Connect the rf voltmeter probe between the TEST HI and ground binding posts on the Model 75D front panel.
      i. Loosen the locking nut on L101 by turning ccw.
      j. Adjust L101 so that the rf voltmeter pointer deflects downscale and indicates < 5 mV.
      k. Tighten the locking nut on L101 by turning cw.
      l. Remove the rf voltmeter.

d. Phase Detector Peaking (L203).

(1) Test equipment: 20 kΩ-per-volt VTVM (or multimeter).
(2) Procedure:

a. Remove the cabinet.
b. Adjust the Model 75D front panel controls in accordance with Table 4.
c. Zero balance the bridge as described in paragraph 3.5.
d. Adjust the VTVM to measure approximately -1.5 V.
e. Connect the VTVM prods between the white terminal on the preamplifier printed circuit board and chassis ground.
f. Adjust the CAPACITANCE control until the NULL INDICATOR pointer is at midscale.
g. Loosen the locking nut on L203 by turning ccw.
h. Adjust L203 maximum indication on the VTVM.
i. Tighten the L203 locking nut by turning cw.
j. Remove the VTVM.

e. DC Amplifier Balance (R302).

(1) Test equipment: None.
(2) Procedure:

a. Remove the cabinet.
b. Adjust the Model 75D front panel controls in accordance with Table 4.
c. Set the MULTIPLY C switch to 0.0001.
d. Zero balance the bridge as described in paragraph 3.5.
e. Set the meter switch to ZERO CENTER.
f. Adjust R302 until the NULL INDICATOR pointer rests exactly at the midscale increment.

f. Internal Phase Shift Alignment (L104).

(1) Test equipment: None.
(2) Procedure:

a. Remove the cabinet.
b. Adjust the Model 75D front panel controls in accordance with Table 4.
c. Set the MULTIPLY C switch to 0.01.
d. Set the DIVIDE G/MULTIPLY R switch to 10.
e. Zero balance the bridge as described in paragraph 3.5.

f. Set the meter switch to ZERO CENTER.
g. Check that the NULL INDICATOR pointer is at the midscale increment. If necessary, adjust the C ZERO FINE control to center the pointer.
h. Turn the CONDUCTANCE control to minus 100 μmhos on the G-scale dial.
i. Loosen the locking nut on L104 by turning ccw.
j. Carefully adjust L104 until the NULL INDICATOR pointer is at the midscale increment, ± 1 subdivision.
k. Carefully tighten the L104 locking nut by turning cw.

4.10 BRIDGE-ASSEMBLY CAPACITANCE ALIGNMENT AND CALIBRATION.

a. The following procedures align or calibrate the capacitive elements in the bridge assembly. The procedure in paragraph c, however, is a calibration check of the CAPACITANCE control on the 1 multiplier range rather than a calibration adjustment. Calibration at the 1 multiplier range is beyond the capability of the user since it involves special-purpose equipment and highly specialized techniques.

NOTE:

Do NOT perform any procedure except paragraph c unless authorization is given by the Boonton Electronics Corporation. If the seals on the bridge assembly are broken or removed without authorization, the Model 75D warranty is null and void.

b. C ZERO Control Alignment (C505).

1. Remove the Model 75D cabinet (par. 4.12).
2. Remove the bridge assembly cover plate (par. 4.13).
3. Adjust the Model 75D front panel controls in accordance with Table 4.
4. Set the MULTIPLY C switch to 0.0001.
5. Zero balance the bridge as described in paragraph 3.5.
6. Set the MULTIPLY C switch to 1. (Do not zero-balance the bridge.)
7. Adjust C505 for a maximim dip of the NULL INDICATOR pointer. The pointer does not have to dip to zero, but it must be in the LO sector of the meter scale; if necessary, fine-trim the 12 o'clock position of the R/G ZERO control.

c. Checking the CAPACITANCE Control Calibration on the 1 Multiplier Range.

(1) Test equipment: One each Capacitance Standard CS-1000, CS-500, and CS-100 (Boonton Electronics Corporation), or equivalent 1000 pF, 500 pF, and 100 pF capacitance standards. Two RG-58/U coaxial cables, each approximately four inches long and terminated in BNC connectors.

(2) Procedure:

a. Adjust the Model 75D front panel controls in accordance with Table 4.
b. Set the DIVIDE G/MULTIPLY R switch to 100.
c. Connect one end of an RG-58/U cable to the REMOTE TEST HI connector on the Model 75D front panel, and connect one end of the other RG-58/U cable to the REMOTE TEST LO connector.
d. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-1000.
e. Zero-balance the bridge as described in paragraph 3.5.
f. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-1000.
g. Adjust the CAPACITANCE and the CONDUCTANCE controls for a null indication on the meter. Read the CAPACITANCE dial.
h. Correct for RG-58/U inductance by multiplying the length of the cable pair (inches) by 0.58 pF and subtracting the product from the CAPACITANCE dial reading derived in Step (g), above. (For example, a four-inch cable pair is 4 X 0.58 pF = 2.32 pF, which is subtracted from the CAPACITANCE dial reading.)
i. Refer to paragraph 1.4,a, and check the corrected pF reading derived in Step h, above, for conformity with the capacitance accuracy specification. If the corrected pF reading is not consistent with the accuracy specification, refer to the note at the end of this procedure.
j. Remove the CS-1000 from the coaxial cables.
k. Set the CAPACITANCE control to zero and the CONDUCTANCE control to G-scale zero.
l. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-500.
m. Zero-balance the bridge as described in paragraph 3.5.
n. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-500.
o. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CAPACITANCE dial.
p. Correct for RG-58/U inductance by multiplying the length of the cable pair (inches) by 0.16 pF and subtracting the product from the CAPACITANCE dial reading derived in Step o, above.

q. Refer to paragraph 1.4,a, and check the corrected pF reading derived in Step p , above, for conformity with the capacitance accuracy specification. If the corrected pF reading is not consistent with the accuracy specification, refer to the note at the end of this procedure.

r. Remove the CS-500 from the coaxial cables.

s. Set the CAPACITANCE control to zero and the CONDUCTANCE control to G-scale zero.

t. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-100.

u. Zero balance the bridge as described in paragraph 3.5.

v. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-100.

w. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CAPACITANCE dial and compare it with the CS-100 value. (No correction for cable inductance is required at 100 pF.)

x. Refer to paragraph 1.4,a, and check the pF reading derived in Step w , above, for conformity with the capacitance accuracy specification. If the corrected pF reading is not consistent with the accuracy specification, refer to the note below.

y. Remove the CS-100.

NOTE:

If the pF readings in Steps i , q , and x , above, are not consistent with the accuracy specification, the Model 75D should be returned to the factory for calibration. Prior to shipment, please call on either the Boonton Electronics Corporation or your nearest engineering representative.

d. Calibrating the CAPACITANCE Control on the 0.1 Multiplier Range (C507).

(1) Test equipment: Capacitance Standard CS-100 (Boonton Electronics Corporation) or equivalent 100 pF capacitance standard. Two RG-58/U coaxial cables, each approximately four inches long and terminated in BNC connectors.

(2) Procedure:

a. Check that one RG-58/U cable is connected to the REMOTE TEST LO connector on the Model 75D front panel, and the other RG-58/U cable is connected to the REMOTE TEST HI connector.

b. Adjust the Model 75D front panel controls in accordance with Table 4, except set the MULTIPLY C switch to .1 .

c. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-100.

d. Zero-balance the bridge as described in paragraph 3.5.

e. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-100.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CAPACITANCE dial and compare the reading with the CS-100 value.
g. Refer to paragraph 1.4,a, and check the pF reading derived in Step f, above, for conformity with the capacitance accuracy specification. If the accuracy of the pF reading is not consistent with the specification, perform Steps h through o, below.
h. Remove the CS-100 and the coaxial cables from the Model 75D.
i. Remove the Model 75D cabinet (par. 4.12).
j. Set the CAPACITANCE control to zero and the CONDUCTANCE control to G-scale zero.
k. Remove the cover plate from the bridge assembly (par. 4.13).
l. Repeat Steps c through g, above.
m. Set the CAPACITANCE control to the exact value stamped on the CS-100.
n. Adjust C507 for a null indication on the meter.
o. Remove the CS-100.

e. Calibrating the CAPACITANCE Control on the 0.01 Multiplier Range (C510).

(1) Test equipment: Capacitance Standard CS-10 (Boonton Electronics Corporation) or equivalent 10 pF capacitance standard. Two RG-58/U coaxial cables, each approximately four inches long and terminated in BNC connectors.

(2) Procedures:

a. Check that the following conditions are observed: the Model 75D cabinet is removed, the bridge assembly cover plate is removed, one RG-58/U cable is connected to the REMOTE TEST LO connector on the Model 75D and the other RG-58/U cable is connected to the REMOTE TEST HI connector.
b. Adjust the Model 75D front panel controls in accordance with Table 4, except set the MULTIPLY C switch to .01.
c. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-10.
d. Zero-balance the bridge as described in paragraph 3.5.
e. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-10.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CAPACITANCE dial and compare the reading with the CS-10 value.
g. Refer to paragraph 1.4,a, and check the pF reading derived in Step f, above, for conformity with the capacitance accuracy specification. If the accuracy of the pF reading is not consistent with the specification, perform Steps h through j, below.

h. Set the CAPACITANCE control to the exact value stamped on the CS-10.
i. Adjust C510 for a null indication on the meter.
j. Remove the CS-10.

f. Calibrating the CAPACITANCE Control on the 0.001 Multiplier Range (C514).

(1) Test equipment: Capacitance Standard CS-1 (Boonton Electronics Corporation) or equivalent 1 pF capacitance standard. Two RG-58/U coaxial cables, each approximately four inches long and terminated in BNC connectors.
(2) Procedure:

a. Check that the following conditions are observed: the Model 75D cabinet is removed, the bridge assembly cover plate is removed, one RG-58/U cable is connected to the REMOTE TEST LO connector on the Model 75D and the other RG-58/U cable is connected to the REMOTE TEST HI connector.
b. Adjust the Model 75D front panel controls in accordance with Table 4, except set the MULTIPLY C switch to 0.001.
c. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-1.
d. Zero-balance the bridge as described in paragraph 3.5.
e. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-1.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CAPACITANCE dial and compare the reading with the CS-1 value.
g. Refer to paragraph 1.4,a, and check the pF reading derived in Step f above, for conformity with the capacitance accuracy specification. If the accuracy of the pF reading is not consistent with the specification, perform Steps h through j, below.
h. Set the CAPACITANCE control to the exact value stamped on the CS-1.
i. Adjust C514 for a null indication on the meter.
j. Remove the CS-1.

g. Calibrating the CAPACITANCE control on the 0.0001 Multiplier Range (C515).

(1) Test equipment: Capacitance Standard CS-0.1 (Boonton Electronics Corporation) or equivalent 0.1 pF capacitance standard. Two RG-58/U coaxial cables, each approximately four inches long and terminated in BNC connectors.
(2) Procedure:

a. Check that the following conditions are observed: the Model 75D cabinet is removed, the bridge assembly cover plate is removed, one RG-58/U cable is connected to the REMOTE

TEST LO connector on the Model 75D and the other RG-58/U cable is connected to the REMOTE TEST HI connector.

b. Adjust the Model 75D front panel controls in accordance with Table 4, except set the MULTIPLY C switch to 0.0001.

c. Connect the free end of the REMOTE TEST LO cable to either terminal on the CS-0.1.

d. Zero-balance the bridge as described in paragraph 3.5.

e. Set the meter switch to ZERO CENTER. If necessary, adjust the C ZERO FINE control until the NULL INDICATOR pointer is centered.

f. Connect the free end of the REMOTE TEST HI cable to the remaining terminal on the CS-0.1.

g. Adjust the CAPACITANCE and CONDUCTANCE controls for a center null indication on the meter. Read the CAPACITANCE dial and compare the reading with the CS-0.1 value.

h. Refer to paragraph 1.4,a, and check the pF reading derived in Step g, above, for conformity with the capacitance accuracy specification. If the pF reading accuracy is as specified, proceed to Step k, below. If the accuracy of the pF reading is not consistent with the specification, perform Steps i through k, below.

i. Set the CAPACITANCE control to the exact value stamped on the CS-0.1.

j. Adjust C515 for a center null indication on the meter.

k. Remove the CS-0.1 and coaxial cables. Install the bridge assembly cover plate (par. 4.13). Install the Model 75D chassis in its cabinet (par. 4.12).

4.11 BRIDGE ASSEMBLY CONDUCTANCE CALIBRATION CHECK.

a. Calibration of the CONDUCTANCE control is beyond the capability of the user since it involves special-purpose equipment and highly specialized techniques. The following procedures, however, will permit the user to verify the calibration of the CONDUCTANCE control on all four ranges. Follow the procedures as a semiannual check.

b. Checking CONDUCTANCE R-Scale Calibration on the 1000 Multiplier Range.

(1) Test equipment: One 1 MΩ deposited-carbon resistor, 1%, 1/4 watt or 1/2 watt.

(2) Procedure:

a. Adjust the Model 75D front panel controls in accordance with Table 4.

b. Remove the terminal shield from the front panel binding posts.

c. Set the MULTIPLY C switch to 0.01.

d. Zero-balance the bridge as described in paragraph 3.5.

e. Connect the one megohm resistor between the TEST HI and LO binding posts. Insert the resistor pigtails fully into the binding posts and tighten securely.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CONDUCTANCE R-scale dial.
g. Refer to paragraph 1.4,d, and check the CONDUCTANCE R-scale reading for conformity with the resistance accuracy specification. If the CONDUCTANCE R-scale reading is not consistent with the specification, refer to the note at the end of paragraph 4.11,e.
h. Remove the 1 MΩ resistor.

c. Checking CONDUCTANCE R-Scale Calibration on the 100 Multiplier Range.

(1) Test equipment: One 100 kΩ deposited carbon resistor, 1%, 1/4 watt or 1/2 watt.
(2) Procedure:

a. Adjust the Model 75D front panel controls in accordance with Table 4.
b. Check that the terminal shield is removed from the front panel binding posts.
c. Set the MULTIPLY C switch to 0.01 and the DIVIDE G/MULTIPLY R switch to 100.
d. Zero balance the bridge as described in paragraph 3.5.
e. Connect the 100 kΩ resistor between the TEST HI and LO binding posts and tighten securely.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CONDUCTANCE R-scale dial.
g. Refer to paragraph 1.4,d, and check the CONDUCTANCE R-scale reading for conformity with the resistance accuracy specification. If the CONDUCTANCE R-scale reading is not consistent with the specification, refer to the note at the end of paragraph 4.11,e.
h. Remove the 100 kΩ resistor.

d. Checking CONDUCTANCE R-Scale Calibration on the 10 Multiplier Range.

(1) Test equipment: One 10 kΩ deposited carbon resistor, 1%, 1/4 watt or 1/2 watt.
(2) Procedure:

a. Adjust the Model 75D front panel controls in accordance with Table 4.
b. Check that the terminal shield is removed from the front panel binding posts.
c. Set the MULTIPLY C switch to 0.01 and the DIVIDE G/MULTIPLY R switch to 10.

d. Zero-balance the bridge as described in paragraph 3.5.
e. Connect the 10 kΩ resistor between the TEST HI and LO binding posts. Insert the resistor pigtails fully into the binding posts and tighten securely.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CONDUCTANCE R-scale dial.
g. Refer to paragraph 1.4,d, and check the CONDUCTANCE R-scale reading for conformity with the resistance accuracy specification. If the CONDUCTANCE R-scale reading is not consistent with the specification, refer to the note at the end of paragraph 4.11,e.
h. Remove the 10 kΩ resistor.

e. Checking CONDUCTANCE R-Scale Calibration on the 1 Multiplier Range.

(1) Test equipment: One 1 kΩ deposited carbon resistor, 1%, 1/4 watt or 1/2 watt.
(2) Procedure:

a. Adjust the Model 75D front panel controls in accordance with Table 4.
b. Check that the terminal shield is removed from the front panel binding posts.
c. Set the MULTIPLY C switch to 0.01 and the DIVIDE G/MULTIPLY R switch to 1.
d. Zero-balance the bridge as described in paragraph 3.5.
e. Connect the 1 kΩ resistor between the TEST HI and LO binding posts and tighten securely.
f. Adjust the CAPACITANCE and CONDUCTANCE controls for a null indication on the meter. Read the CONDUCTANCE R-scale dial. Correct readings from Figure 9, Page 28.
g. Refer to paragraph 1.4,d, and check the CONDUCTANCE R-scale reading for conformity with the resistance accuracy specification. If the CONDUCTANCE R-scale reading is not consistent with the specification, refer to the note, below.
h. Remove the 1 kΩ resistor.

NOTE:

If the CONDUCTANCE control accuracy does not agree with the specification, the Model 75D should be returned to the factory for calibration. Prior to shipment, please call on either the Boonton Electronics Corporation or your nearest sales engineering representative.

4.12 MODEL 75D CABINET

a. Removal.

(1) Check that the power cable is uncoiled and not connected to an ac receptacle.
(2) Check that the power switch on the front panel is off.
(3) Remove the two screws at each side of the front panel and remove the two edge strips.
(4) Grasp the two front panel handles and pull the Model 75D chassis out of the cabinet.
(5) Feed the power cable through the cutout on the rear of the cabinet.

b. Installation. Installation is the reverse of Steps 5, 4, and 3 in paragraph a, above. However, when sliding the chassis into the cabinet in Step 4, be sure that the two pins inside the rear of the cabinet are fully seated in the two ports on the rear of the chassis.

4.13 BRIDGE

NOTE:

Before proceeding, be sure that the Boonton Electronics Corporation has authorized the user to perform maintenance on the bridge assembly.

a. Cover Plate Removal.

(1) Place the chassis on a bench so that the bridge assembly is accessible.
(2) At the junction of the bridge assembly cover and the cover plate, slit the three seals.
(3) Remove the six attaching screws and lift up the rear plate.

b. Cover Plate Installation. Use the six attaching screws to secure the cover plate to the bridge assembly cover.

Table 6. Troubleshooting Chart

	Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
1.	Dead instrument.	1	Power loss.	Check that power cable is connected to ac power. Check FUSE F601. Troubleshoot power supply.
2.	No bias voltage across TEST and REMOTE HI and ground terminals or across DC BIAS INTERNAL MONITOR E and ground binding posts when DC BIAS switch is at +INT.	8	Open circuit in positive-bias line.	Trace +150V bias circuit of T602 power supply.
3.	No bias voltage across TEST and REMOTE HI and ground terminals or across DC BIAS INTERNAL MONITOR E and ground binding posts when DC BIAS switch is at -INT.	8	a. Open circuit in negative-bias line. b. Shorted zener diode.	a. Trace -6.8V bias circuit of T602 power supply. b. Check CR603.
4.	Poor voltage regulation of internal positive bias.	8	Defective regulator tube.	Check V602, Check R603.
5.	Poor voltage regulation of internal negative bias.	8	Defective zener diode.	Check CR603.

Table 6. Troubleshooting Chart (Cont'd)

Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
6. No bias voltage across TEST and REMOTE HI and LO terminals when DC BIAS switch is either at +INT or -INT, but normal bias voltages can be measured across DC BIAS INTERNAL MONITOR E binding posts. (See note in par. 4.6)	8	a. Jumper is missing.	a. Check that bias jumper is installed between DC BIAS EXTERNAL LO and ground binding posts.
		b. Defective part in bias filter network.	b. Check L502* and L503* for open circuit; check C516* and C518* for short circuit.
		c. Open circuit.	c. Check L501* for open circuit.
7. No bias voltage across TEST and REMOTE HI and LO terminals when single bias is applied at DC BIAS EXTERNAL HI and LO binding posts, bias jumper is installed between LO post and ground, and DC BIAS switch is at EXT. (See Note in par. 4.6)	--	a. Defective part in bias filter network.	a. Check L502* and L503* for open circuit; check C516* and C518* for short circuit.
		b. Open circuit.	b. Check L501* for open circuit.
8. No bias voltage across TEST and REMOTE HI and ground terminals when dual bias is applied at DC BIAS EXTERNAL HI and ground binding posts, bias jumper is removed, and DC BIAS switch is at EXT. (See Note in par. 4.6)	--	Defective part in bias filter network.	Check L502* and L503* for open circuit; check C516* and C518* for short circuit.

* Located in bridge assembly

Table 6. Troubleshooting Chart (Cont'd)

	Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
9.	No bias voltage across TEST and REMOTE LO and ground terminals when bias is applied at DC BIAS EXTERNAL LO and ground binding posts, bias jumper is removed, and DC BIAS switch is at EXT. (See Note in par. 4.6)	--	Open circuit in bias loop.	Check L501* for open circuit.
10.	No current indication on milliammeter plugged into DC BIAS INTERNAL MONITOR I jack when test specimen is connected between TEST or REMOTE HI and LO terminals and DC BIAS switch is either at +INT or -INT. However, normal bias voltage can be measured between TEST and REMOTE HI and ground terminals and between DC BIAS INTERNAL MONITOR E and ground binding posts. (See Note in par. 4.6)	9	Open circuit in bias loop.	Check that bias jumper is installed between DC BIAS EXTERNAL LO and ground binding posts. Check L501* for open circuit. Check DC BIAS INTERNAL MONITOR I jack for faulty make-and-break contacts.
11.	Meter either cannot be completely nulled or it exhibits extreme left deflection during zero balance. Meter switch is at ZERO LEFT.	2,3,4 5,7	Faulty alignment.	Adjust R307 (par. 4.8).

* Located in bridge assembly

Table 6. Troubleshooting Chart (Cont'd)

	Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
12.	Meter pointer deflects offscale when bridge circuit is unbalanced slightly. Meter switch is at ZERO LEFT.	--	a. Faulty alignment b. Open circuit or defective part in rf agc loop between V201 and V101.	a. Adjust L203 (par.4.9,d). b. Troubleshoot agc circuit.
13.	ZERO LEFT and ZERO CENTER meter nulls are not synchronized.	3	a. Faulty alignment. b. Defective part in CR202-CR203 network or in V301 stage.	a. Adjust L203 (par. 4.9,d). Adjust R302 (par. 4.9,e). b. Troubleshoot CR202-CR203 network and V301 stage.
14.	Inadequate ranging of PHASE control.	4	Faulty alignment.	Adjust L104 (par. 4.9,f). Adjust L203 (par. 4.9,d).
15.	Excessive phase drift.	4	a. Faulty alignment b. Poor regulation.	a. Same as Step 14, above. b. Check V602 and R603. Check Q601-Q602 regulator circuit of T601 power supply.
16.	Poor sensitivity and resolution when meter switch is at ZERO LEFT.	5	a. Defective part in Q201 or V202 stage.	a. Check Q201 and V202. Check Y201 and Y202. Troubleshoot V202 stage.

Table 6. Troubleshooting Chart (Cont'd)

Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
17. Poor sensitivity and resolution when meter switch is at ZERO CENTER.	5	a. Faulty alignment.	a. Adjust L203 (par. 4.9,d).
		b. Defective part in V301 stage.	b. Check V301. Troubleshoot V301 stage.
18. Poor sensitivity and resolution when meter switch is at ZERO LEFT or ZERO CENTER.	5	a. Faulty alignment.	a. Adjust L205 (par. 4.9,b). Adjust L101 (par. 4.9,c). Adjust L104 (par. 4.9,f).
		b. Defective part in V101, V102, V201 or V203 stage.	b. Check V101, V102, V201 and V203. Troubleshoot each stage.
19. Meter pointer does not respond to zero-balance adjustments when meter switch is at ZERO LEFT. However, meter can be nulled at ZERO CENTER.	2,3,4, 5,7	Defective part in Q201 or V202 stage.	Check Q201 and V202. Check Y201 and Y202. Troubleshoot V202 stage.
20. Meter pointer does not respond to zero-balance adjustments when meter switch is at ZERO CENTER. However, meter can be nulled at ZERO LEFT.	2,3,4,5	Defective part in V301 or V302 or in CR202-CR203 network.	Check V301 and V302. Troubleshoot V301 and V302 stages and CR202-CR203 network.
21. Meter pointer does not respond to zero-balance adjustments when meter switch is at ZERO LEFT or ZERO CENTER.	2,3,4, 5,7	a. Defective dc filament supply.	a. If there is no filament glow on tubes V101 thru V201 check T601 filament supply.

Table 6. Troubleshooting Chart (Cont'd)

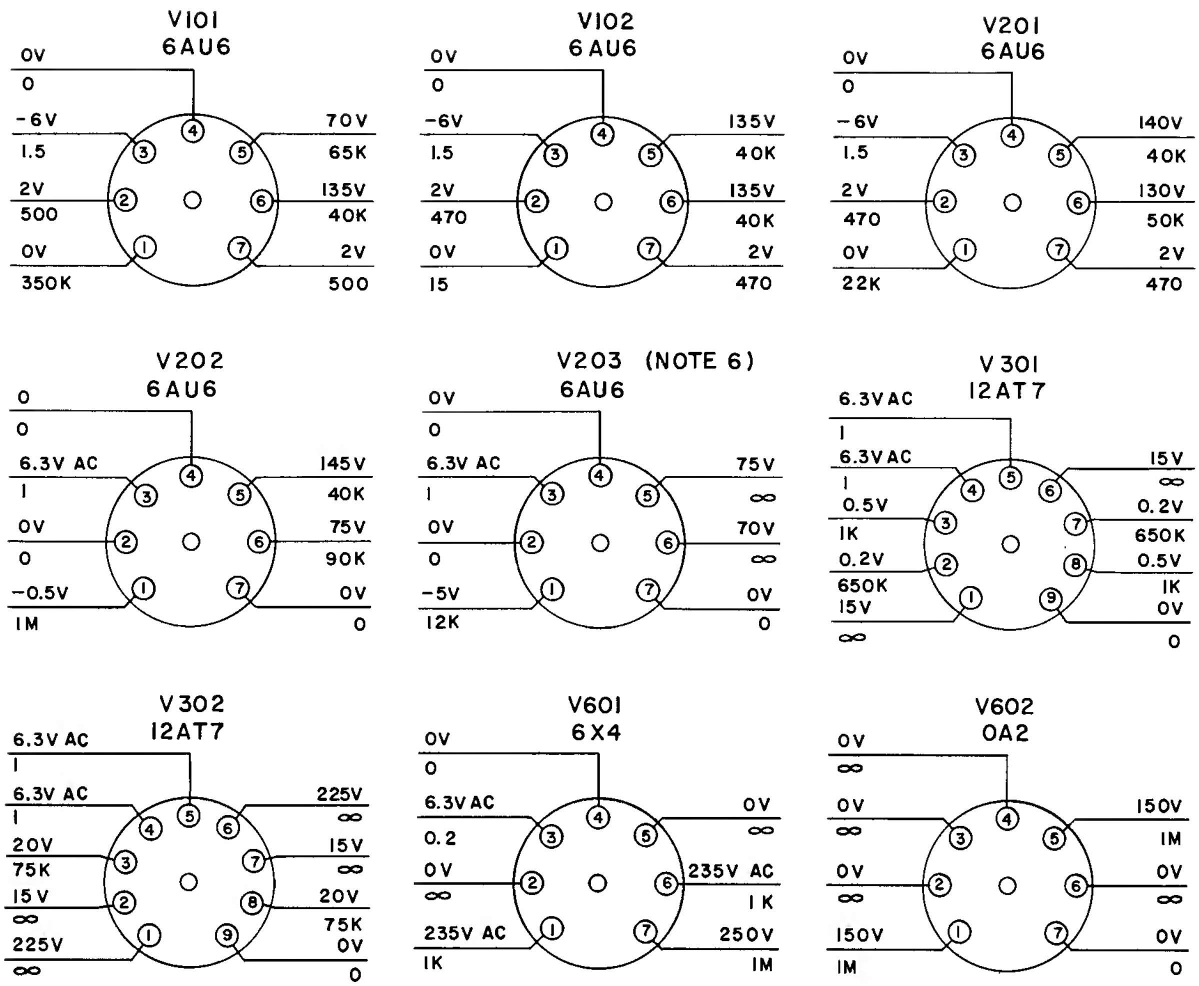
Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
21. (Cont'd)			
	2,3,4 5,7	b. Open circuit in ac filament line.	b. Check that C110 is not shorted. If there is no filament glow on tubes V202 thru V302 and the pilot lamp is extinguished, check 6.3V ac circuit of T602 power supply.
	2,3,4, 5,7	c. Loss of B+	c. If filaments appear normal, check +210V and +150V circuits of T602 power supply.
	2 thru 7	d. Faulty alignment of oscillator stage V203.	d. Temporarily disconnect P201 and measure with rf voltmeter at J201 for approximately 750 mV. If voltage is below normal, adjust L205 for maximum indication on the rf voltmeter and then perform the procedure in paragraph 4.9,b. If there is no output at J201 proceed to Step e, below. If normal voltage is measured at J201 proceed to Step f below.
	6	e. Defective part in V203	e. Check V203. Check Y203. Troubleshoot V203 stage.

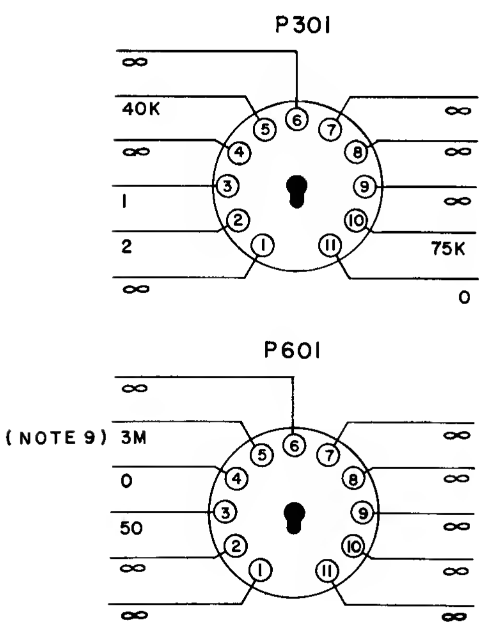
Table 6. Troubleshooting Chart (Cont'd)

Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
21. (Cont'd)	2 thru 7	f. Defective part in bridge assembly.	f. Check that the TEST LEVEL control is fully clockwise, and use rf voltmeter to measure at TEST LO and ground binding posts for approximately 250 mV. Then set MULTIPLY C switch at 1, temporarily disconnect P101, advance the CAPACITANCE control to 1000, and measure with rf voltmeter at TEST HI and ground binding posts for approximately 250 mV. If either voltage is absent, the bridge assembly probably is defective. Call on the manufacturer for consultation. If correct voltages are measured, proceed to Step g, below.
	2,3,4, 5,7	g. Defective part in V101, V102, or V201 stage.	g. Check tubes first and then troubleshoot stages V101, V102, and V201. NOTE: The Model 75D warranty will be null and void if the following procedures are performed without authorization from the Boonton Electronics Corporation. (See Note in paragraph 4.10.)

Table 6. Troubleshooting Chart (Cont'd)

Symptom	Associated Performance Standard (see Table 5)	Probable Fault	Corrective Action
22. Bridge will not balance when MULTIPLY C switch is in the 1 position and meter switch is at ZERO LEFT or ZERO CENTER.	3,4, 5,7	Faulty alignment	Adjust C505 (par. 4.10,b).
23. Inaccurate reading on CAPACITANCE dial when MULTIPLY C switch is in the .1 position.	4D,i	The .1 range is out of calibration.	Adjust C507 (par. 4.10,d).
24. Inaccurate reading on CAPACITANCE dial when MULTIPLY C switch is in the .01 position.	4C,i	The .01 range is out of calibration.	Adjust C510 (par. 4.10,e).
25. Inaccurate reading on CAPACITANCE dial when MULTIPLY C switch is in the .001 position.	4B,i	The .001 range is out of calibration.	Adjust C514 (par. 4.10,f).
26. Inaccurate reading on CAPACITANCE dial when MULTIPLY C switch is in the .0001 position.	4A,i	The .0001 range is out of calibration.	Adjust C515 (par. 4.10,g).





NOTES.

1. VOLTAGES ARE ABOVE THE LINES, RESISTANCES BELOW.
2. MEASUREMENTS MADE WITH 20KΩ PER VOLT VTVM OR MULTIMETER, NEGATIVE PROD AT CHASSIS GROUND.
3. UNLESS OTHERWISE SPECIFIED, VOLTAGES ARE DC AND RESISTANCES ARE IN OHMS: $K = 10^3$, $M = 10^6$, AND ∞ = INFINITY.
4. ALL VALUES ARE ±20%.
5. BEFORE MEASURING VOLTAGES, DISCONNECT P101 AND REMOVE TUBE V203.
6. INSTALL TUBE V203 WHEN MEASURING VOLTAGES AT V203 ONLY.
7. AFTER MEASURING VOLTAGES RECONNECT P101 AND INSTALL V203.
8. BEFORE MEASURING RESISTANCES, DISCONNECT P301 AND P601, AND CHECK THAT POWER SWITCH IS IN OFF POSITION.
9. SET ZERO LEFT/ZERO CENTER SWITCH TO THE ZERO LEFT POSITION.
10. WHEN RESISTANCE MEASUREMENTS ARE COMPLETED, RECONNECT P301 TO J301 AND P601 TO J601.

Figure 10. Voltage-Resistance Test Chart.

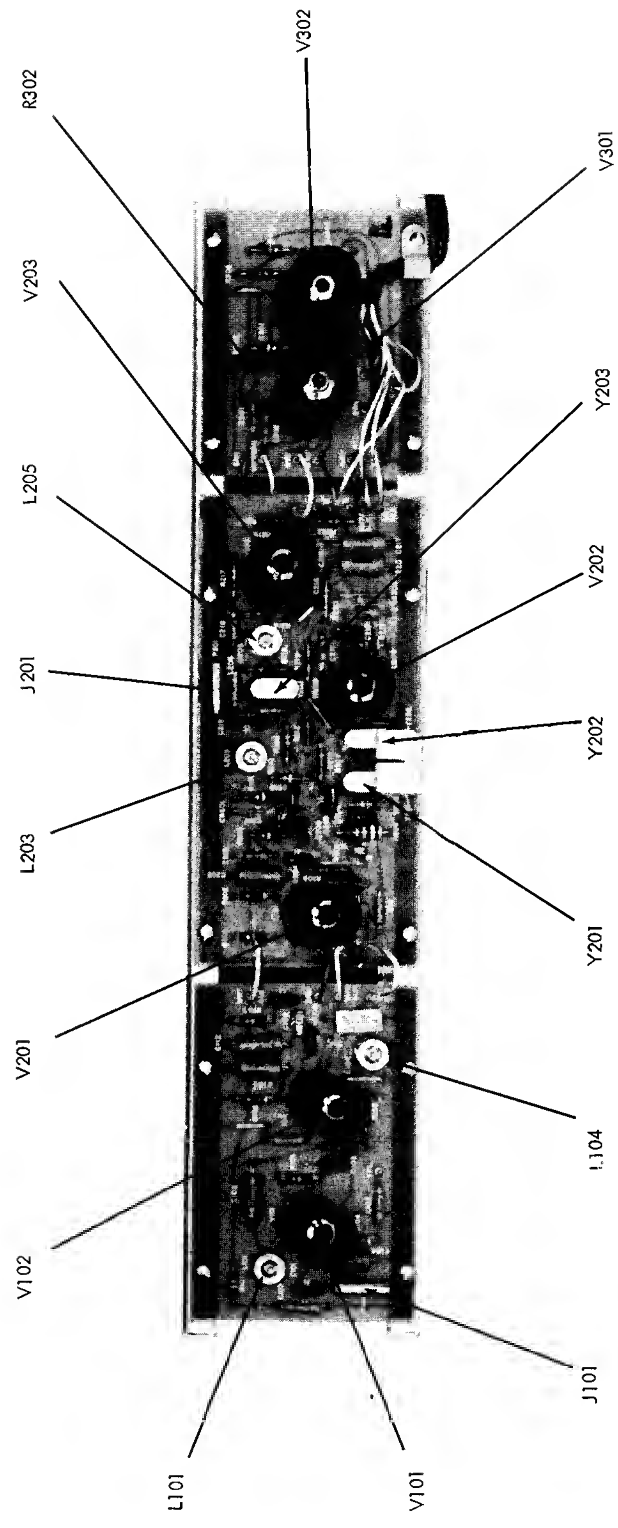


Figure 11. Oscillator-Detector Assembly

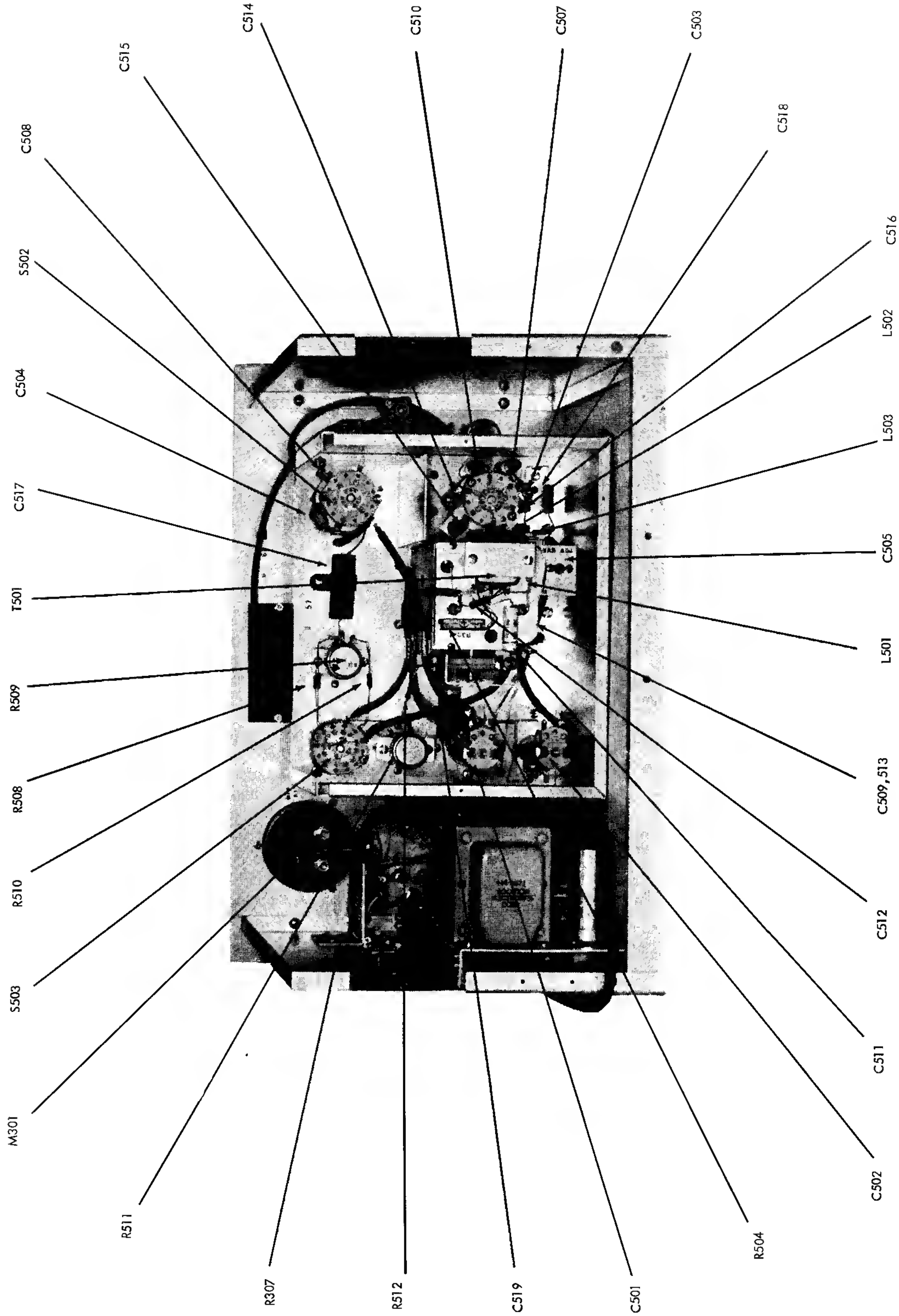


Figure 12. Model 75D Bridge Assembly (With Cover Removed)

TABLE OF REPLACEABLE PARTS

NOTE: Components in the bridge assembly have been listed in a separate Table following this one. In general, their replacement must be followed by adjustments that require special equipment and techniques.

- Capacitors -

Reference		Description		BEC Part No.
C101	Durmica	150pF ± 5% 500V	Arco DM-15-151J	200032
C102	Mylar	0.01μF ± 10% 200V	Sprague 192P10392	234027
C103	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C104	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C105	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C106	Ceramic	36pF ± 5% 500V	Erie N750	220117
C107	Var. Air	3-15pF	Hammarlund MAPC-15B	275149
C108	Durmica	150pF ± 5% 500V	Arco DM-15-151J	200032
C109	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C110	Met. Paper	0.5μF ± 20% 100V	Electron Products M1-504	234034
C111	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C112	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C201	Mylar	0.1μF ± 10% 500V	Sprague 192P10492	230116
C202	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C203	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C204 &5	Durmica	330pF ± 1% 500V	Arco DM-15-331F	200033
C206	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C207	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C208	Ceramic	36pF ± 5% 500V	Erie N 750	220117
C209	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C210	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C211	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C212	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C213	Durmica	240pF ± 5% 500V	Arco DM-15-241J	200506
C214	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C215	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C216	Durmica	300pF ± 5% 500V	Arco DM-15-301J	200034
C217	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C218	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C219	Durmica	1300pF ± 2% 500V	G.I. RDM19FD132G03	200518
C220	Mylar	0.1μF ± 10% 200V	Sprague 192P10492	230116
C301	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C302	Mylar	0.002μF ± 5% 200V	Sprague 192P20252	234024
C401	Mylar	0.047μF ± 10% 400V	Sprague 192P47394	234047
C601	Electrolytic	1000μF 15V	Mallory WP-039A	283101
C602	Electrolytic	20-20μF 450V	Mallory FP-234A	283100

- Resistors -

Reference		Description		BEC Part No.
R101	Comp.	220K ± 5% 1/2 Watt	AB Type EB	301143
R102	Comp.	2.2K ± 5% 1/2 Watt	AB Type EB	301095
R103	Comp.	22K ± 5% 1/2 Watt	AB Type EB	301119
R104	Comp.	470 Ω ± 5% 1/2 Watt	AB Type EB	301079
R105	Comp.	2.2K ± 5% 1/2 Watt	AB Type EB	301095
R106	Comp.	470Ω ± 5% 1/2 Watt	AB Type EB	301079
R107	Comp.	22K ± 5% 1/2 Watt	AB Type EB	301119
R108	Var.	50K ± 10% 2 Watt	AB Type J	311125
R201	Comp.	220K ± 5% 1/2 Watt	AB Type EB	301143
R202	Comp.	470Ω ± 5% 1/2 Watt	AB Type EB	301079
R203	Comp.	10K ± 5% 1/2 Watt	AB Type EB	301111
R204	Comp.	39K ± 5% 1 Watt	AB Type GB	302139
R205	Comp.	220K ± 5% 1/2 Watt	AB Type EB	301143
R206	Comp.	10M ± 5% 1/2 Watt	AB Type EB	301183
R207	Comp.	2.2 K ± 5% 1/2 Watt	AB Type EB	301095
R208	Comp.	2.2 K ± 5% 1/2 Watt	AB Type EB	301095
R209	Comp.	10K ± 5 % 1/2 Watt	AB Type EB	301111
R210	Comp.	510K ± 5% 1/2 Watt	AB Type EB	301152
R211	Comp.	1M ± 5% 1/2 Watt	AB Type EB	301159
R212	Comp.	1M ± 5% 1/2 Watt	AB Type EB	301159
R213	Comp.	1M ± 5% 1/2 Watt	AB Type EB	301159
R214	Comp.	510K ± 5% 1/2 Watt	AB Type EB	301152
R215	Comp.	47K ± 5% 1/2 Watt	AB Type EB	301127
R216	Comp.	2.2K ± 5% 1/2Watt	AB Type EB	301095
R217	Comp.	10K ± 5% 1/2 Watt	AB Type EB	301111
R218	Comp.	10Ω ± 5% 1/2 Watt	AB Type EB	301039
R219	Comp.	22K ± 5% 1/2 Watt	AB Type EB	301119
R220	Comp.	75K ± 5% 1/2 Watt	AB Type EB	301132
R221	Comp.	75K ± 5% 1/2 Watt	AB Type EB	301132
R222	Comp.	10K ± 5% 1/2 Watt	AB Type EB	301111
R301	Comp.	510K ± 5% 1/2 Watt	AB Type EB	301152
R302	Var.	2K ± 10% 1 Watt	Bourns 3007P-1-202	311264
R303	Comp.	510K ± 5% 1/2 Watt	AB Type EB	301152
R304	Comp.	75K ± 5% 1/2 Watt	AB Type EB	301132
R305	Comp.	10K ± 5% 1/2 Watt	AB Type EB	301111
R306	Comp.	2.7M ± 5% 1/2 Watt	AB Type EB	301169
R307	Var.	1M ± 10% 1/10 Watt	CRL-BA-001-390	311142

- Resistors -

Reference		Description		BEC Part No.
R401	Var. W.W.	50K ± 5% 10 Turn	Clarostat 62-JA-50K	311198
R402	Comp.	24K ± 5% 2 Watt	AB Type HB	304120
R505	Var.	5K ± 10% 2Watt	AB Type J	311202
R601	Comp.	2K ± 5% 1/2 Watt	AB Type EB	301094
R602	Comp.	1M ± 20% 1 Watt	AB Type GB	302128
R603	W. W.	2K ± 5% 5-1/4Watt	Ohmite 2901	310110
R604	Comp.	2.2Ω ± 5% 1/2 Watt	AB Type EB	301501
R605	Comp.	120Ω ± 5% 1/2 Watt	AB Type EB	301065

- Diodes -

Reference	Description		BEC Part No.
CR201	Silicon 1N914	Texas Instrument	530058
CR202	Silicon 1N914	Texas Instrument	530058
CR203	Silicon 1N914	Texas Instrument	530058
CR204	Germanium 1N58A	Sylvania	530021
CR301	Silicon 1N914	Texas Instrument	530058
CR302	Silicon 1N914	Texas Instrument	530058
CR601	Silicon Bridge SPF-GR	Solitron	532006
CR602	6.2V Zener 1N753	Motorola	530062
CR603	6.8V Zener UZ806	Unitrode	530041

- Transistors -

Reference	Description		BEC Part No.
Q201	FET 2N5459	Motorola	528019
Q601	PNP 2N404	Texas Instrument	528009
Q602	PNP 2N554	Motorola	528003

- Tubes -

Reference	Description	BEC Part No.
V101	6 AU 6	526 6AU6
V102	6 AU 6	526 6AU6

- Tubes (Cont'd) -

Reference	Description	BEC Part No.
V201	6 AU 6	526 6AU6
V202	6 AU 6	526 6AU6
V203	6 AU 6	526 6AU6
V301	12 AT7	526 12AT7
V302	12 AT7	526 12AT7
V601	6 X 4	526 6X4
V602	0A2	526 0A4

- Inductors -

Reference		Description		BEC Part No.
L101	Var. RF	100-175μH	North Hills 1500A	400115
L102	RF	3300 μH	Stanwyck Dink-3300	400213
L103	RF	1000μH	Stanwyck Dink-1000	400135
L104	Var. RF	100-175μH	North Hills 1500A	400115
L201	RF	10mH	Stanwyck Dink-10,000	400143
L202	RF	10mH	Stanwyck Dink-10,000	400143
L203	Var.RF	100-175μH	North Hills 1500A	400115
L204	RF	3300μH	Stanwyck Dink-3300	400213
L205	Var.RF	100-175μH	North Hills 1500A	400115
L206	RF	4.7 μH	Stanwyck Dink - 4.7	400144
L601	Power	7H 500Ω 50mA	Stancor C1707	440001

- Transformers -

Reference	Description		BEC Part No.
T601	12.6V Filament	Stancor P8130	446010
T602	Power	Stancor 1377	446007

- Switches -

Reference		Description		BEC Part No.
S301	Slide DPDT	Continental Wirt	Type G-326	465125
S401	Rotary 2P-4Pos	Oak	Type J	466171
S601	Toggle SPST	Carling 110-63		465105

- Miscellaneous -

Reference		Description		BEC Part No.
M301	Meter	50-0-50μA	Ammon Type AM-3	554181
Y201	Crystal	1MHz ± 10Hz	Valpey-Fisher Type VR6	547020
Y202	Crystal	1MHz ± 10Hz	Valpey-Fisher Type VR6	547020
Y203	Crystal	1MHz ± 10Hz	Valpey-Fisher Type VR6	547020
F601	Fuse(Slo Blo)	0.5A 250V	Buss MDL 1/2	545504
PL601	Lamp	14V 80mA	GE Type 330	545110

TABLE OF REPLACEABLE PARTS

Bridge Assembly

NOTE: Replacement of these components must be followed by adjustments requiring special equipment and techniques.

Capacitors

Reference		Description		BEC Part No.
C501	Var. Air	0.3 - 0.4 pF	Jackson Bros. (Spec.)	275123
C502	Var. Air	2 x 3 - 13 pF	Jackson Bros. (Spec.)	275129
C503	Var. Air	0.4 - 8 pF	Johanson 1802	279101
C504	Var. Cer.	4.5 - 25 pF	Erie NPO	281000
C505	Var. Air	3.2 - 50 pF	Hammarlund MAPC 50	275103
C506	Mica	100 pF ±1% 500V	Arco (selected)	201124
C507	Var. Air	0.7 - 30 pF	Johanson 1902	279103
C508	Var. Poly.	0.7 - 3 pF	Erie 535-008-4R	279109
C510	Var. Air	0.7 - 30 pF	Johanson 1902	279103
C511	Mylar	.022 µF ±10% 200V	Sprague 192P22392	230101
C512	Mylar	0.15 µF ±10% 400V	Sprague 192P15494S4	230141
C514	Var. Air	0.4 - 8 pF	Johanson 1802	279101
C515	Var. Air	.01 - 1.5 pF	Johanson 4484	279111
C516	Mylar	.047 µF ±10% 400V	Sprague 192P47394	234047
C517	Met. Paper	1.0 µF ±20% 400V	Aerovox P8292ZN22	235021
C518	Mylar	.047 µF ±10% 400V	Sprague 192P47394	234047
C519	Met. Paper	0.5 µF ±20% 400V	Aerovox P8292ZN21	230118

Resistors

Reference		Description		BEC Part No.
R501	Metal Film	681Ω ±1% 3/8 W	T. I. MC60D	326086
R502	Dep. Carbon	301Ω ±1% 1/4 W	Mepco C10	305177
R503	Dep. Carbon	4.75K ±1% 1/4 W	Mepco C10	305321
R504	Variable	2K ±10% 1/4 W	Bourns 200L-1-202	311203
R505	Variable	5K ±10% 2 W	AB Type J	311202
R506	Dep. Carbon	49.9K ±1% 1/4 W	Mepco C10	305442
R507	Dep. Carbon	499K ±1% 1/4 W	Mepco C10	305562
R509	Variable	250Ω ±10% 2 W	AB (special)	311161
R511	Variable	10K ±10% 2 W	AB type J	311124
R512	Metal Film	499K ±1% 3/8 W	T.I. MC60D	326561

Inductors

Reference		Description		BEC Part No.
L501	RF	1000 μH ±5%	Essex	400095
L502	RF	1000 μH ±5%	Essex	400095
L503	RF	1000 μH ±5%	Essex	400095

Transformers

Reference	Description		BEC Part No.
T501	Bridge Transformer	BEC Special	075212

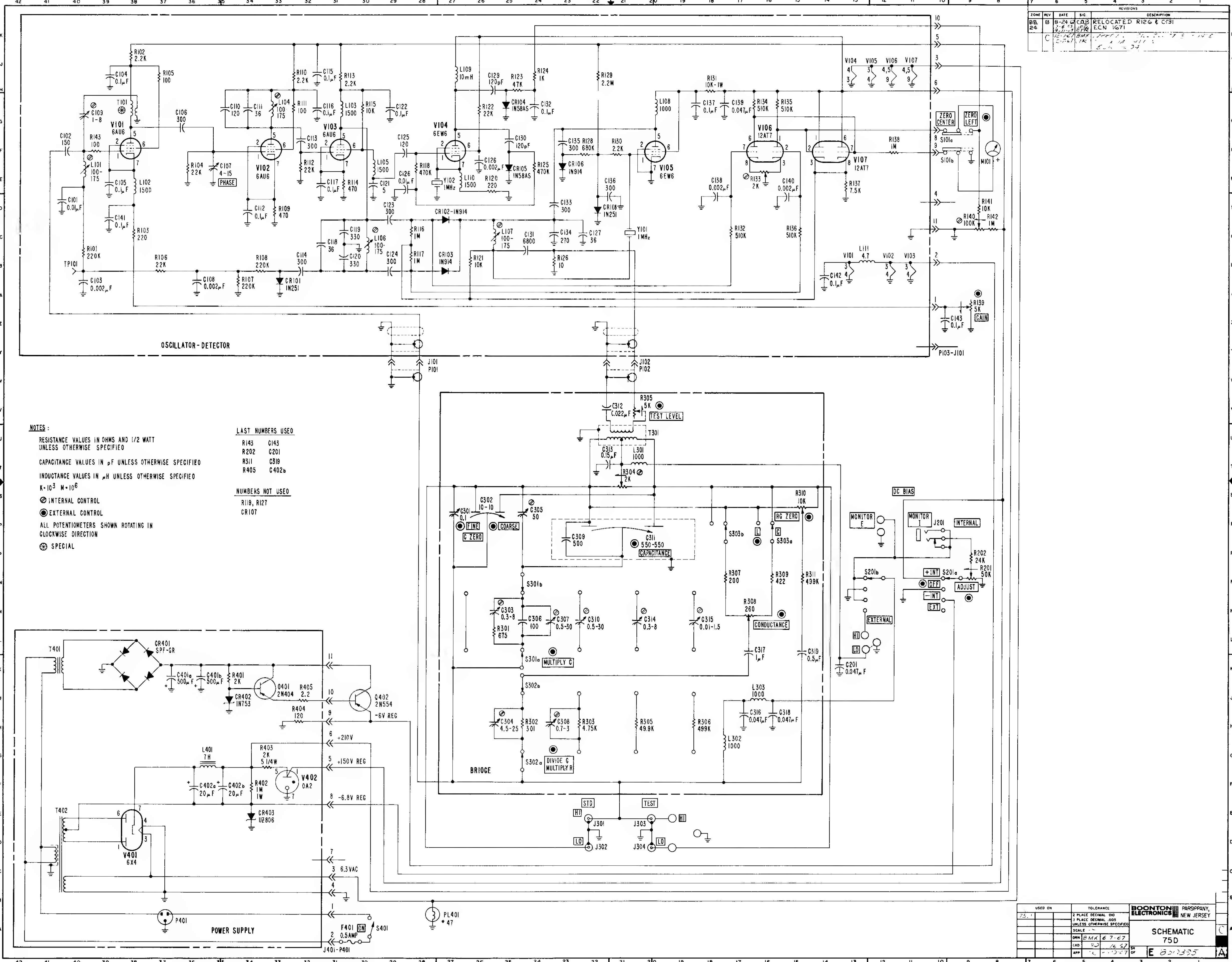
Warranty

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to vacuum tubes that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty. Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

BOONTON ELECTRONICS CORPORATION

Telephone: 201-887-5110
TWX: 710-986-8241
Route 287, Parsippany, N. J. – 07054


OSCILLATOR - DETECTOR
BRIDGE
POWER SUPPLY
NOTES:
RESISTANCE VALUES IN OHMS AND 1/2 WATT UNLESS OTHERWISE SPECIFIED
CAPACITANCE VALUES IN pF UNLESS OTHERWISE SPECIFIED
INDUCTANCE VALUES IN μH UNLESS OTHERWISE SPECIFIED
K=10³ M=10⁶
INTERNAL CONTROL
EXTERNAL CONTROL
ALL POTENTIOMETERS SHOWN ROTATING IN CLOCKWISE DIRECTION
SPECIAL
LAST NUMBERS USED
R143 C143
R202 C201
R311 C319
R405 C402b
NUMBERS NOT USED
R119, R127
CR107
REVISIONS
ZONE REV DATE SIG DESCRIPTION
BB 24 B RELOCATED R126 & C131 ECN 1671
C
PHASE
FINE
C ZERO
COARSE
CAPACITANCE
TEST LEVEL
RG ZERO
CONDUCTANCE
MULTIPLY C
DIVIDE G MULTIPLY R
ZERO CENTER
ZERO LEFT
GAIN
DC BIAS
MONITOR E
MONITOR I
INTERNAL
EXTERNAL
ADJUST
+INT
OFF
-INT
EXT
STD
TEST
HI
LO
-6V REG
+210V
+150V REG
-6.8V REG
6.3VAC
0.5AMP
ON
J401-P401
P103-J101
BOONTON ELECTRONICS PARSIPPANY, NEW JERSEY
SCHEMATIC 75D
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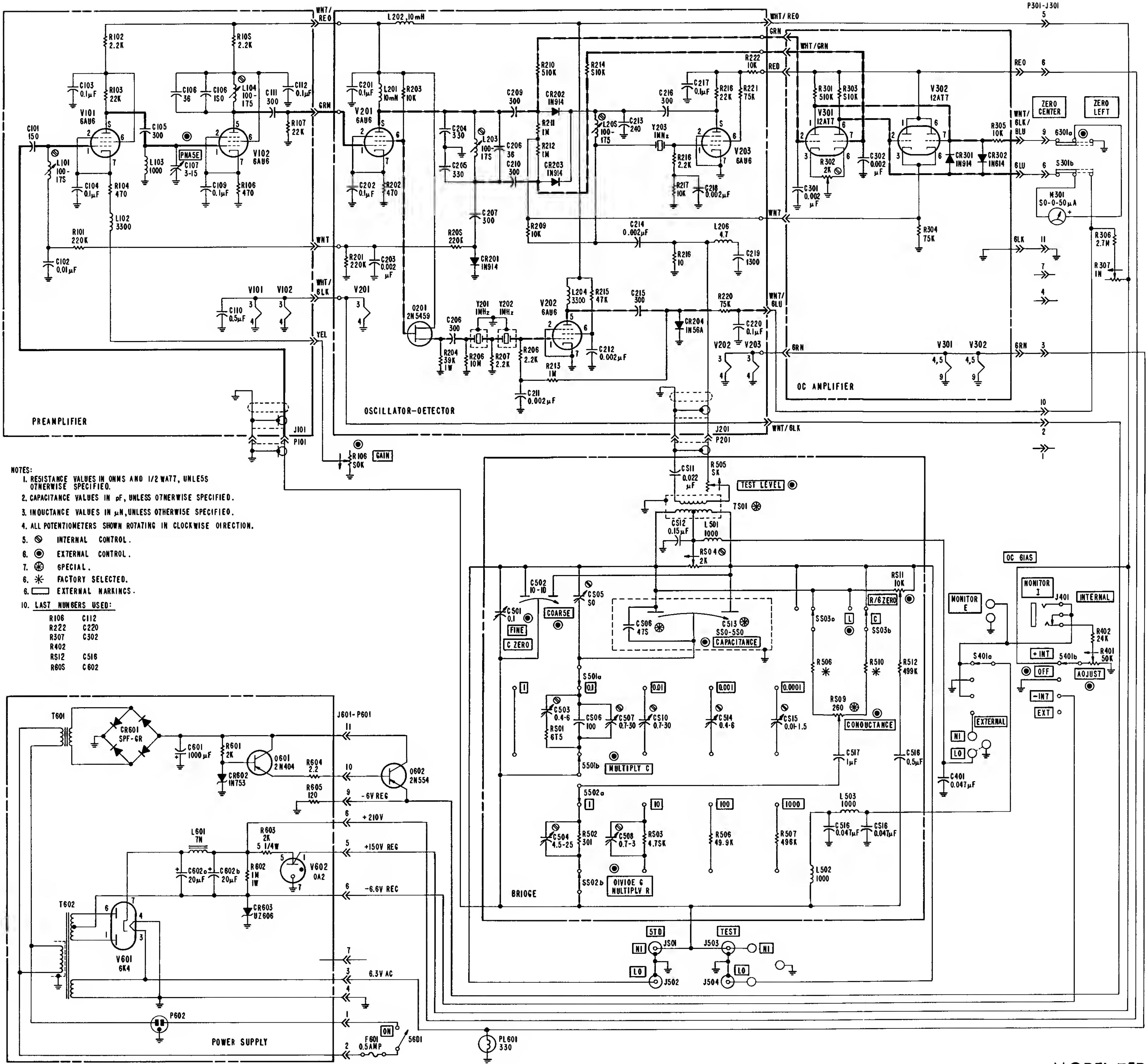


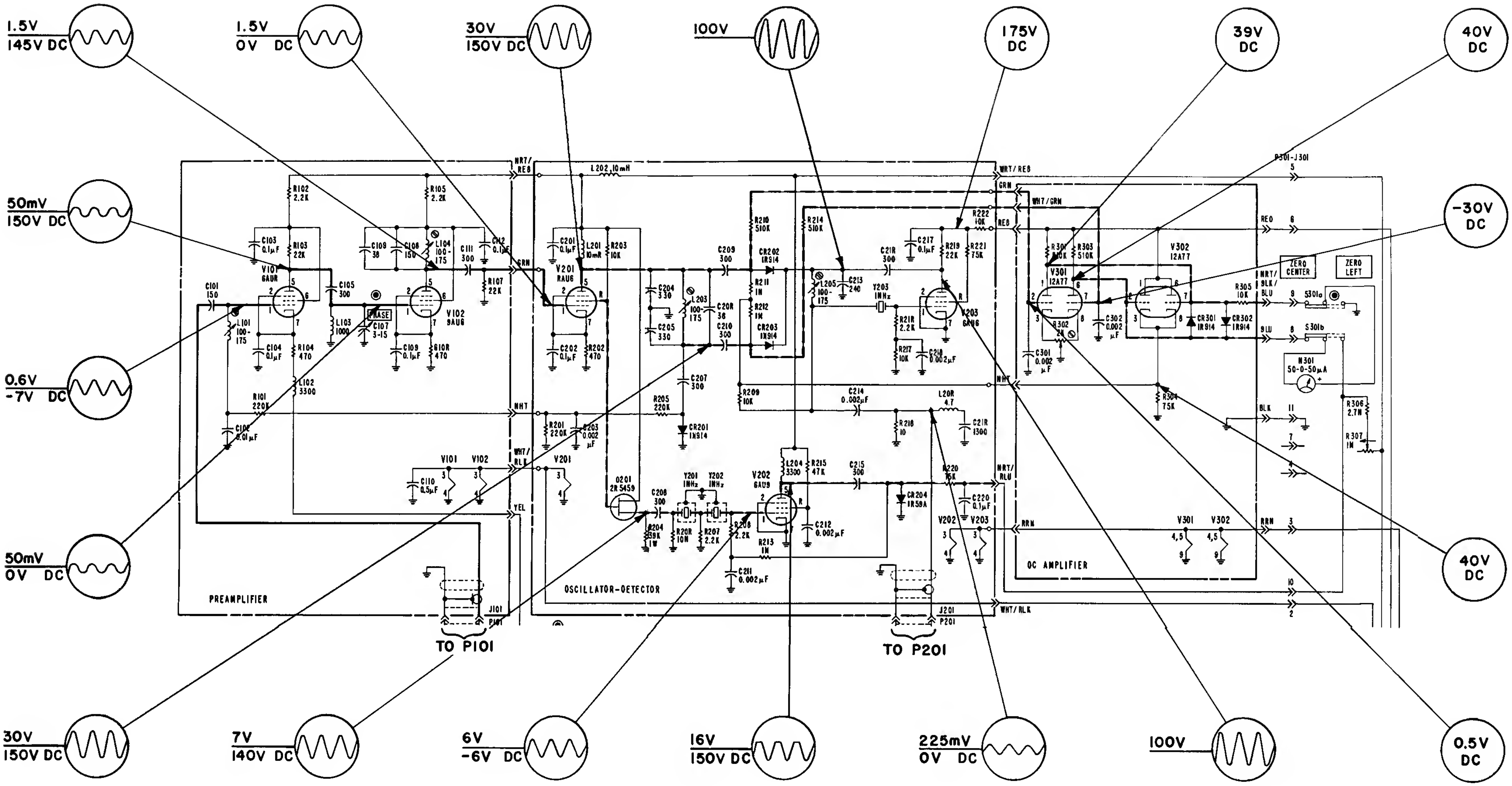
NOTES:

1. RESISTANCE VALUES IN OHMS AND 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
2. CAPACITANCE VALUES IN pF, UNLESS OTHERWISE SPECIFIED.
3. INDUCTANCE VALUES IN μH, UNLESS OTHERWISE SPECIFIED.
4. ALL POTENTIOMETERS SHOWN ROTATING IN CLOCKWISE DIRECTION.
5. ⊘ INTERNAL CONTROL.
6. ◉ EXTERNAL CONTROL.
7. ⊛ SPECIAL.
8. ✳ FACTORY SELECTED.
9. ▭ EXTERNAL MARKINGS.
10. LAST NUMBERS USED:

R106	C112
R222	C220
R307	C302
R402	
R512	C516
R605	C602

BOONTON ELECTRONICS CORPORATION

MODEL 75D
Schematic
830395K



NOTES:

1. AC MEASUREMENTS MADE WITH TEKTRONIX TYPE 310A OSCILLOSCOPE USING 15pF PROBE GROUNDED TO 75D CHASSIS.
2. DC MEASUREMENTS MADE WITH BOONTON ELECTRONICS MODEL 95A VTVM, 10 MΩ INPUT RESISTANCE, GROUNDED TO 75D CHASSIS.
3. VALUES ABOVE THE LINE AT EACH WAVEFORM ARE 1MHz RF PEAK-TO-PEAK VOLTAGES: VALUES BELOW THE LINE ARE DC VOLTAGES.
4. ALL VALUES ARE ± 20%.
5. PERFORM THE FOLLOWING ADJUSTMENTS BEFORE MAKING MEASUREMENTS.
   a. ADJUST OSCILLOSCOPE FOR OPERATION.
   b. ADJUST 75D FRONT PANEL CONTROLS IN ACCORDANCE WITH TABLE 3-2.
   c. SET MULTIPLY C SWITCH TO 0.1 RANGE.
   d. ZERO BALANCE THE BRIDGE (PARA. 3-5b.)
   e. UNBALANCE THE BRIDGE BY SETTING THE CAPACITANCE CONTROL TO 1000pF.

BOONTON ELECTRONICS CORPORATION

MODEL 75D
Test Points and Waveforms
830412B